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ELECTRICAL WORLD AND ENGINEER.

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THE ELECTRICAL CONGRESS.

It will be seen from the extended report that we are able to give, with the aid of the telegraph, that the fifth International Electrical Congress at St. Louis has been the great success that its careful organization promised to make of it. Although still in its closing hours as we go to press, it is evident that in no whit will it fall below its predecessors and that in some respects it will surpass them—in adhesions, attendance and number of excellent papers presented. The man who owns the set of congress transactions will indeed be fortunate, if we may judge from the abstracts that reach us from St. Louis of the papers and discussions. Moreover, the work of the official chamber of delegates has now assumed importance, and the appointment by England and France of members of the upper chamber, while too tardy to be altogether gracious, is timely enough to permit participation by these two important countries in votes and decisions that are necessarily freighted with important results to the science. Probably the method of settling the great questions of the standards of the art will change at no distant date, but meantime, we must make the best of prevailing conditions. One happy feature of the Congress is the number of electrical engineers from abroad participating in it. They not only make it truly international, but their presence has afforded an opportunity for cultivating that closer personal knowledge and friendship upon which all mutual action for the common good must be based.

AMERICAN APATHY.

All good American engineers and citizens have been very busily engaged the last two or three months in showing friends from abroad the marvels of our civilization, and in accepting with an ill-concealed modesty the hearty and spontaneous compliments on our enterprise, our ardor, our promptitude to take up and perfect new things, our zeal in introducing and popularizing the latest inventions and discoveries. The complacency that has expanded many an American's white vest and brought the glow of patriotic pride to his face is decidedly lessened on reading the remarks of so distinguished a visitor as Sir William Ramsay, of argon fame, who thinks American manufacturers decidedly apathetic and behind the times. He says they are not sufficiently alert: "The majority of them do not make it a practice to read scientific journals or to familiarize themselves with the latest trend of scientific thought. English manufacturers are far ahead of Americans in this respect, and Germany shows a clean pair of heels to both." And then he goes on calmly to substantiate this damning indictment with facts and figures. Sir William is the best friend this country has to-day. He may not be quite exact, but it is well to be told by a frank, friendly and discerning critic that other countries are up and doing, and that this people also must be as alert and aggressive in pursuit of the new and the knowable as it ever was at any stage of its development.

ELECTRICITY AND THE WAR.

Electricity cannot be said, after all, to have played a very conspicuous part in the Russo-Japanese war, except in regard to the use of wireless telegraphy. But just how far that has been brought into play nobody yet knows. The Japanese admit its useful employment in their navy, and assert that the Russians have depended upon it in communicating with Port Arthur, but beyond that all is very vague. Then one reads a good deal about the use of searchlights,

and about the telephone in the field, all of which is interesting, though hardly to be characterized as novel. One little touch of the unusual we note in recent dispatches as follows with regard to Kuroki's flank attack on Kuropatkin near Liao-Yang: "The Russians had strung along the ground heavy wires highly charged with electricity, and as the Japanese soldiers ran against the wires in the darkness, they received shocks." All of which is interesting if true. Why the wires should be heavy, and why the shocks did not kill, is not explained. We have heard before of innocuous dead wires that made hands tingle and caused brave men to tremble, and possibly these in the last analysis would fall into the same category. Even those resistless little Japs can imagine dangerous currents and fatal shocks under the weird conditions of a groping night attack. But, meantime, where are all the submarine boats? Have they done anything, and if so, is it being sedulously concealed from the tenth evening editions of an enterprising American press?

MECHANICAL DESIGN OF ARMATURE COILS.

During the days of hand-wound coils the designer of electrical machinery was careful to allow sufficient space at the end of the armature coil for the overlapping of the coils, and was compelled to depend upon the armature winder to place the turns in the proper slots and to prevent excessive bulging at the ends. At that time the process of winding required skilled men, employed at correspondingly large wages. The greatest advantage gained from using machine-wound coils lies in the fact that the placing of the coils on the core can be accomplished rapidly and accurately by men and boys who have had almost no preliminary training, while the use of such coils results in an armature well balanced both mechanically and electrically, but the task of the designer has been rendered to some degree less difficult.

The difficulty encountered in the mechanical design of form-wound coils is attributable to the fact that a section of each coil must advance at a certain angle, then change planes through a half turn and continue to advance to the proper slot. If the angle chosen be too acute, an excess of material will be required, while if the angle be too large, the coils cannot be forced to place. The maximum value of the angle is limited by the ratio of width of core lug to the coil slot, and by the thickness of the insulation, or, more properly, by the ratio of the size of the total circumferential arc devoted to each coil and the thickness of the insulated coil. The determination of the exact slope of the finished coil is increased in difficulty when the throw of the coil covers a relatively large portion of the circumference of the core.

When the size of the core, the throw and over-all dimensions of the coil are known, the proper shape to be given the coil ends may be ascertained from a practical application of solid geometry, as is shown on page 461 of this issue. The formulas given are intended to apply to that type of winding in which the coil ends form a surface continuous with the core—the type most frequently employed. The method outlined, however, by obvious modifications, can be applied to any type of winding desired, the allowance for insulation, in many cases, being determined by the voltage of the machine and the character of the material used.

ELECTRICAL RAILWAYS IN GERMANY.

We Americans are sometimes wont to think that ours is the only country fully able to grasp the importance of electric traction, and imagine that all the rest of the world is hopelessly behind the game. To look at the matter quite dispassionately, the United States is certainly in the lead by a very large amount as regards the magnitude of the electric railway business, and particularly in swift and efficient grasp of the interurban situation. We have the biggest plants, the most cars, the most traffic, the most enterprise, and the most painfully frequent deficits. Greatness has its penalties, and occasional over-confidence is one of them. A recent number of our valued contemporary, the *Elektrotechnische Zeitschrift,* is in large measure devoted to a very comprehensive *resumé* of German progress in electric railway building, and while, of course, the numerical achievements recorded are not striking from an American standpoint, the impression left upon the reader is one of most commendable enterprise and of a sound and healthy growth under conditions not altogether favorable. As a rule Continental cities are rather compact, lacking the widely scattered suburban population so common here. The necessary result of this is that on the Continent the amount of track required is far less than here, and, the distances being shorter, more people are disposed to walk. Add to this the relatively less income of the common people abroad, and the total of nearly 3,500 miles of electric track in Germany last year represents an amount of progress by no means unsatisfactory. Something like seven-eighths of this is the growth of the last seven years, for the overhead trolley did not fairly get a grip in the land of its birth until it had been for half a dozen years growing strong and healthy here. Like many another German-American it emigrated early and found prosperity and improvement in the land of its adoption.

Looking over the summation of the German roads, one is struck naturally enough by the relatively large amount of double track, a necessary result of considerable growth in compact centers of population. A more significant difference from American practice is the relatively large number of trailers in use, a number rising to about three-fourths the number of motor cars. This to a certain extent corresponds to early American practice, but with this difference: that the Germans have gone into trailer work with their eyes open, after the modern long car had been fully developed here. Germany is certainly not foolishly conservative in technical matters, and we cannot avoid the conclusion that the trailer is found to be advantageous under German conditions of traffic. There is much to be said for it even here, although it has tended to pass out of use. It forms a very convenient way of increasing traffic capacity, and ought to be especially applicable where there is less desperate rushing and overcrowding than here. As is well known to our readers, German electric railway working is as regards equipment rather generally similar to our own, and American equipment has been often utilized there, but of minor differences there are many. Possibly the most striking one is the frequent use of the sliding trolley instead of our familiar trolley wheel, which leads to some simplification to the overhead work and removes the chance of the trolley coming off the wire. Collectors of the German type have been occasionally tried in this country, generally with good results, but, not being adapted to our common overhead work, they have not come into active competition with the ordinary form. From the standpoint of distribution, the most interesting feature of German practice is the very extensive use of storage batteries, both in the stations and upon outlying points of the lines. Taking the German railways as a whole the battery capacity connected is nearly 30 per cent. of the dynamo rating. And what is more significant, the growth of these battery installations has been particularly great within the last two years. For example, the station capacity in the year prior to last October increased 11.4 per cent., while the battery capacity increased 28.6 per cent. Battery working has long been a feature of German central station practice, and thus its application in electric railways was to be expected, although the extent of such use is impressive. The American plan of power transmission at high voltage to sub-stations with rotaries has hardly

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found a foothold in Germany owing to the comparatively small number of long lines there operated.

The German roads seem on the whole to be conservatively planned, with moderate grades and routes carefully chosen so that the output required per car is rather moderate. We wish that returns of cost, operating expenses and receipts had been included in the report, for while they could not fairly be compared with the data obtained here, they would be highly instructive. The low costs of labor usual on the Continent have a profound influence on electrical methods in many ways and would certainly be strongly in evidence in electric traction. The tramway fares, too, are on an entirely different basis, which renders comparison with American roads doubly difficult. But it can hardly be doubted that the operative results on the German roads are good, as is usually the case on relatively short lines with rather dense traffic. Certainly electric traction has extinguished animal traction quite as effectively there as here. The interurban road will come slowly in Germany, but there is a keen interest in it nevertheless. The governmental ownership of the railways necessarily tends to check interurban enterprises save as they may become a part of the Government's policy.

ELECTRICITY AT THE WORLD'S FAIR.

Since it is the special purpose and utility of any exhibition to reveal and crystallize the progress that has been achieved in each art and industry, a series of pictures of electrical exhibits at the successive World's Fairs since the Philadelphia Centennial would reveal at a glance the development in electrical applications during the last thirty years. At Philadelphia, the dynamo was exhibited in small sizes, as a novelty of very recent date. At St. Louis, the dynamo of ten thousand horse-power excites less wonder than its little predecessors of three decades ago. Not only has the building space alloted to electricity and electrical exhibits increased with each successive exposition, but the applications of electricity have in recent years outgrown their building limitations and have pervaded the entire precincts of the Exposition. At the present time, electricity not only occupies one entire building at the St. Louis Fair, with an area of nine acres, but it operates the intramural railroad, illumines the buildings, works the fountains, actuates the hoists, and subserves numerous mechanical exhibits by furnishing the propulsive motors. In view of these facts, a casual observer might describe the St. Louis World's Fair as a great electrical exposition aided and illustrated by all the arts and industries.

The genius of a nation invariably manifests itself in the disposition and arrangement of its World's Fairs. At a Fair in Paris and a Fair in America, the various countries of the world display products essentially similar, and one would suppose at first suggestion that the aggregate display would be substantially the same in either case. But the guiding impulses of the nation which holds the Fair are inevitably displayed in the plan and distribution. At a Paris Exposition, art is the keystone of the entire structure; Art displayed in beautiful buildings, in the prominence of painting, in the richness of decoration and the grace of design. In building after building charming and artistic productions arise on every side to greet the eye. In a distant and sequestered nook is discovered a machinery hall. At an American Fair, the programme is inverted. Hall after hall is filled with machinery. Transportation machinery, tools, mechanisms, farm machinery, electrical machinery, guns, printing-presses and apparatus of all kinds come for their successive share of attention. In some remote district of the Fair Grounds one can find the Art Gallery, with the aid of an official guide-book. Each of these two types of Exhibition has its strength and its defects, its advantages and its weaknesses.

As an Exhibition, the St. Louis World's Fair presents a wonderfully harmonious grouping of stately buildings. At Chicago, the buildings stood out in contrast. At St. Louis they stand up in symmetry. The great extent of the grounds—almost two square miles—is not made apparent to the observer at first sight, so skilful is the general design; until after studying some section of the Fair, it becomes noticeable how much remains unexplored. No one can hope to know all that is set forth to see and admire. Indeed, it would seem that, in the mind of observers, the degree of resemblance between the exhibits of any one department at St. Louis and those of the corresponding department at Chicago, is in somewhat inverse proportion to the knowledge possessed in that particular art. Thus, to an electrical engineer, the difference between the electrical exhibits at St. Louis and at Chicago, eleven years before, is so great in most lines of development as to be distinct and remote like different stages of floral evolution in successive paleozoic ages. On the other hand, the corresponding changes in other arts and industries seem less and less, as one knows less about them. Yet inquiry of experts in those lines would indicate that the change therein has been similarly wide. From this it would seem that all expositions look alike to the unsophisticated; while to the trained eye, every succeeding exposition is a new revelation.

In the electrical part of the Exposition, there are an unusual number of workable systems and working models or machines. This endows much of the machinery with a livelier interest. In lighting, there are all types and colors, from the purple hue of the mercury vapor lamp to the brilliant white of the Nernst lamp or magnetite arc. The lighting effects of the Exposition at night are very interesting and varied. Some of the prominent structures are wired in red, green and ordinary incandescent lamps; so that the color of the bright outlines can be speedily changed from white to green or to red. The total number of incandescent lamps employed in decorative lighting is about twice as great as at Chicago. A marked feature at St. Louis in contrast with Chicago is the number of electric automobiles perambulating through the grounds. This is a distinct advantage in favor of the sight-seers.

There is a wonderful wealth and profusion of statuary at St. Louis, much of which is characteristic and typical of American Western life during the settler days. Of course there are the usual number of quadrigas in mid-air. Some persons regard it as necessary to have a chariot with three or four pawing horses on the roof of a large building, as if to emphasize an architectural triumph or abortion; but coming down to the more accustomed level of our earth, the groups of statuary are very fascinating and modern, as distinguished from classical and Greek. The largest of all is a colossal iron Vulcan, fifty feet high, in the Mining Building, which, if it had been coeval with the brazen Colossus of Rhodes, would probably have ranked as an eighth wonder of the world. Steel Common is represented by the Lagoons. Taking the Exposition as a whole, St. Louis may well be proud of her accomplishment, two hundred and forty years after being established as a fur-trading post for the Indians. Originally French, then Spanish, again French, and finally American, its cosmopolitan spirit has found expression in an exhibition from all parts of the world. Taking it as an exposition of electrical progress and enterprise, the advance since Centennial days has been marvellous, and since Chicago very great. Taking high-pressures as an example, there are 50-kilowatt switches in evidence to-day, whereas at Chicago, such pressures neither existed in fact nor were advocated in theory. Many years must probably elapse before we may expect to look upon the like of this St. Louis Fair again this side of the Atlantic.

Foreign Electrical Jurors at St. Louis.

A list of American electrical jurors at the St. Louis Exposition has already been presented in these pages. The foreign jurors include: Group 67, electric generators, E. Soleri, Italy; M. Shubusawa, Japan; M. G. Holzschuch, France. Group 68, electrochemistry, Kasimir Sosnowsky, France. Group 69, electric lighting, Dr. R. Kahle, Germany; Guido Grassi, France. Group 70, telegraphy and telephony, M. Roux and M. Dennery, France. Group 71, various applications of electricity, Dr. C. V. Drysdale, England; M. Silva.

Sustaining Tesla Patent on Appeal.

The United States Circuit Court of Appeals at Boston on September 9 handed down a decision in the case of Westinghouse Electric & Manufacturing Company vs. Stanley Instrument Company, reversing the judgment of the Circuit Court, which dismissed a bill brought with a view to prevent alleged infringement of patents issued to Nikola Tesla relating to conversion of alternating currents of electricity into a continuous current. The lower court dismissed the bill on the ground that complainant had failed to establish by sufficient proofs a conception of the invention by Tesla prior to April 22, 1888, the date of a certain publication in Italy known as the Ferraris publication. Complainant appealed, and the Appellate Court sustains the appeal, remanding the case to the Circuit Court with a direction to enter a decree for plaintiff for an injunction against defendant restraining the latter from infringing the patents, numbered respectively 511,559 and 511,560, and for an accounting.

Defendant had contended that the alleged invention was not addressed to the utilization of two-phased currents in a motor, but to a new way of producing the necessary two out-of-phase currents; that this specific way of producing two out-of-phase currents was old and well known in the art, and was old and well known as an equivalent of the method in a prior patent; that all the methods of producing two or more out-of-phase alternating currents set out in the Tesla patents were, in and of themselves, old and well known in the art as means and methods of producing such out-of-phase currents; and that their laws and limitations had been known and set out in a way not even approximated in accuracy or fulness in any of the Tesla patents. Respondent further maintained that Dr. Kenney had explained the fact that the invention in the patents involved merely the substitution of one means of obtaining two-phase currents for another means; and that he showed that these two means were old and well known equivalents.

The Court says in regard to the contention: "Of course all this was with the purpose of maintaining that there was no invention in any view of the patents now in issue. It unavoidably concedes, however, that, if there were invention, it was fundamental. When under special circumstances a particular practical application of a known principle proves to be of advantage in the arts, and yet the thought of making it had not occurred to those expert therein, such application, at times, involves invention. The corollary of this proposition, which we will apply later, is that, in cases of this character, where the originator has boldly struck out into a practical application, and stated it, though only in general terms, he has, for the most part, made his conception clear, even though the mechanical details have not been expressed or thought out. Therefore Professor Main was right in testifying that, if Tesla made clear his conception in a general way, he made clear his invention, leaving the artisan skilled in electrical science to work out the practical details required in applying what was previously within the bounds of philosophical knowledge.

"With reference to the apparent lack of supporting proof on the part of complainant which has been very much pressed against it, it must be conceded, as is apparent from the general tone of the record and from the way in which the case has been developed before us, that the patent was long acquiesced in. It is also certain that an interference was declared between Ferraris and Tesla and decided in favor of the latter. The difficulty which pressed itself upon us on the question of infringement grows out of the fact that the amount of power used by respondent is very minute. Nevertheless it is power developed, as set out by Blathy's claims, by 'a metallic rotating body,' and transmitted to a 'suitable counting apparatus, operated by the same rotating body.' If the device stopped with 'a metallic rotating body' and some method other than a counting machine operated by it was used for determining the number of its revolutions, we might not be able to charge respondent with infringing. We might then well apply the proposition of respondent that a mere meter is in a different art from a motor, but as it does not stop there we must look further. The Tesla invention, in issue, as already explained by us, derives its right to recognition from the fact that it was applied to the production of power. The ingenuity of Tesla was displayed in the conception of an adaptation to a particular use."

New York State Street Railway Convention.

The twenty-second annual meeting of the Street Railway Association of the State of New York was held at Utica on September 13-14, the headquarters for meeting and exhibits being the New Century Club Auditorium. The regular proceedings began at 10 a. m. Tuesday, September 13, when Mayor Talcott delivered an address of welcome. The report of Secretary Cole showed the Association to be in a healthy condition, although consolidation of electric railways had caused the loss of several members, to some extent offsetting the gains.

An interesting and valuable paper was presented from Mr. M. G. Starrett, engineer of the New York City Railway, on the power production and distribution of that system. It led to an interesting discussion.

Mr. E. G. Connette, president, delivered an admirable address, reviewing the development of transportation in the Mohawk Valley and referring to recent developments on the New York Central and in the introduction of alternating current street railway motors. Mr. H. A. Benedict, of Albany, read an interesting paper on the maintenance of electric cars and their equipment. At the afternoon session a paper was read by Mr. C. R. Van Etten on "Freight Business on Street Railways," while a somewhat similar paper was presented by Mr. L. W. Serrell on "The Question of Freight." He recommended the formation of joint freight and express associations among street railway companies. Mr. G. Dunford, general express agent of the Utica & Mohawk Valley Railway Company, contributed a paper on "A Method of Handling Interurban Express Matter." It dealt with the system in operation by the company.

A committee appointed by the Association to investigate dangers incident to high voltage power transmission lines reported the tests made by it on the lines of the Utica & Mohawk Valley Company, near the Frankfort substation. The report dealt more particularly with methods and reasons for insulation of wooden poles against escaping current at high voltages.

In the evening the annual banquet was given in the banquet hall of the Masonic Temple, when the Hon. John D. Kernan presided, and a series of admirable speeches were delivered by Messrs. George E. Dunham, H. H. Vreeland, Addison B. Colvin, J. M. Wakeman, Secretary W. W. Cole and Dr. M. Woolsey Stryker, president of Hamilton College. The general burden of the speeches was the beneficial service of street railways to the population of New York State. The keynote was struck by Mr. Vreeland, who said: "The services we perform, the taxes we pay, the property we create, the wages we distribute, the inestimable benefits that our industry confers upon the State and the people entitle us to a respectful hearing and fair treatment, and we owe it to ourselves and to the interests we represent to make manful protest against the discrimination and the scandal to which we are so frequently subjected."

The business of the convention was resumed on Wednesday morning when a number of interesting matters were taken up in connection with the Question Box. At the close of the session, the following officers were elected for the ensuing year: President, C. Loomis Allen; first vice-president, J. H. Pardee; second vice-president, A. B. Colvin; secretary and treasurer, W. W. Cole; executive committee, the officers, E. G. Connette, R. E. Danforth, B. B. Nostrand, Jr., and E. F. Peck.

The convention was enlivened by various special entertainments for the ladies and by a trip on Wednesday in special cars through the historical battlefield of Oriskany to Rome, returning to Summit Park, where lunch was served. The local street railway development was naturally the subject of study and commendation. The total attendance reached not less than about 250, and there was the usual active participation on the part of electrical manufacturers and street railway supply men. A number of exhibits were made at the Club headquarters.

The Northern California Power Company's Systems.—II.

KILARC HYDROELECTRIC SYSTEM.

WATER for the operation of the second power plant of the company, which is known as the Kilarc plant, is taken from a mountain stream uneuphoniously called Cow Creek—an important tributary of the Sacramento River. Its source is among mountains having altitudes above 7,000 feet and reaching to the summit of the Sierra Nevada Mountains. As will be seen by Fig. 9

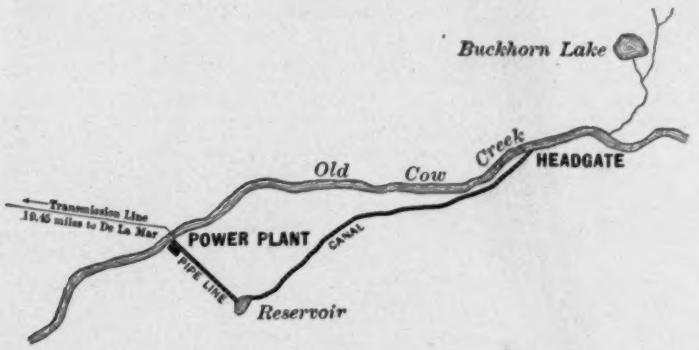


FIG. 9.—HYDRAULIC DEVELOPMENT FOR KILARC PLANT.

the development of the system is simple, consisting of a diversion from the main or Old Cow Creek and the conveyance of the water along the northerly side of a ridge that culminates in Miller's Mountain to a reservoir thereon which stands at the head of the pipe line. This canal consists of 10,600 lineal feet of ditching, 8,576 feet of fluming, and two tunnels aggregating 324 feet in length, so that the entire length of the water way is approximately 3.7 miles. Its watershed, the bulk of which is at an elevation of from 3,800 to 5,000 feet above sea level, contains some 26 square miles with an annual precipitation ranging from 60 to 100 inches, the latter at the higher altitudes. The minimum flow of the creek is far more than ample to supply water for the operation of the present plant, but should the latter be enlarged, three excellent reservoir sites are available and could be utilized at moderate cost.

Interest in the water development for the Kilarc plant centers in its remarkably short length of canal—3.7 miles, as stated—in conjunction with the high head obtained, namely, 1,195 feet. Though slightly more than half the length of the water way is in ditching, the course lays through very favorable ground, as in no instance is the ditch run along a steep hillside. The canal has a mean depth of three feet by a bottom width of seven feet and a top or surface width of ten feet. The area of its water section is 25.5 square feet, its grade is one-quarter of an inch per rod, its calculated velocity is 2.53 feet per second, which is equivalent to a volume of 64.51 feet per second. All the remainder of the waterway is in fluming, for the tunnels enclose fluming that is closely covered in as will be described. In the open the flume is stockily built of red fir and yellow pine with mud sills of cedar and cedar posts on the trestles. Its grade is the same as that of the ditch and its velocity is a trifle over five feet per second, giving a capacity of practically 65 cubic feet per second. Within the tunnels the water is carried in a box flume throughout, the framing of the latter consisting of 6 x 10 and 10 x 10 timbers lagged on the top and sides with 4-inch planking and boarded within with 2-inch red fir and 1-inch battens. In these tunnels the flume has a width of four feet in the clear and is boarded up on the sides for 48 inches, but the water flows only to a depth of 3 feet 2 inches. As the timbers are placed but four feet apart and are very heavy, the work resembles the timbering of a mine, and, in fact, as the tunnels were bored through country rock, mining construction had to be followed out to give permanence and reliability to the work.

The reservoir at the head of the pipe line is contained by an earth-filled dam 15 feet in height, which floods an area of 8 acres and gives thereby a storage capacity of 26,000,000 gallons of water, or sufficient to run the plant at full load for 16 hours. No necessity for larger storage capacity than this is believed to exist, for with the reliability of the flow of water in the creek, the shortness of the canal and the favorable country through which it passes, interruption to the delivery of water to the reservoir beyond the period of time stated is not to be brought about by anything short of a geological catastrophe.

From the reservoir the water enters the forebay through a box flume 14 x 25 feet in cross section and the floating material that may enter it is taken off and discharged over the spillway by means of boards placed on edge and extending two feet below the normal surface of the water. Next a set of grizzlies consisting of ⅞-inch round iron bars is passed, when finally comes a double screen of heavy galvanized iron wire with a 1-inch mesh. This double screen is peculiar in that it is so arranged with levers as to allow the removal of but one screen at a time for examination or cleaning, thus preventing any material from being carried down the pipe line. Finally the water enters a 48-inch wood stave pipe through a gate valve of equal diameter, after having passed through the penstock which is 11 feet wide and 21 feet 6 inches long. This gate is operated on the capstan principle to provide for the emergency of the freezing of the traveling nuts. This stave pipe carries the water to the riveted steel pipe which continues on in varying thicknesses to the power house.

If the consideration of details of construction of the pipe line be begun at the power house, which is the natural starting point to one who goes over the hydraulic system, it will be noted that the pipe line terminates in a horizontal header which runs in line with the lengths of the generator and transformer buildings, and immediately between them, they being ten feet apart. This header has a length of 70 feet, by an inside diameter of 36 inches, and the distance from the first upward bend of the pipe line to the inside wall of the power house is nearly 27 feet. Both the main and the exciter wheels are fed therefrom, the former through separate 15-inch gate valves for each of the four wheels, and the latter through a 6-inch gate which branches through a tee into two 4-inch extra strong pipes, each of which makes an easy bend at a 20-inch radius to a position at right angles to the main pipe, when it is brought down to a 3-inch pipe before reaching its exciter wheel.

The steel pipe line varies in diameter from 36 to 42 inches, and in thickness of walls from 13-16 to ½ an inch, and its course is marked by fourteen vertical bends and one horizontal bend which occurs slightly above the middle of section six and has an angle of 8° 15′.

FIG. 10.—GENERATOR BUILDING AT KILARC.

Three manholes are placed at intervals through the pipe line at points presenting respective pressures of 518, 354 and 263 pounds per square inch. They are bolted on through gaskets and do not contain air valves, the use of which is not necessary. The pipe was laid in a trench generally excavated to bed rock, but where such good footing could not be reached without conflicting with the easy grade on which the pipe was laid, it was supported on stone and concrete piers that reach bedrock. Where the line crosses ravines, or wherever possibility arose for the accumulation of water in the trench from seepage or any other cause, subdrainage through stone culverts was provided for, and after the pipe was laid the trench was, of course, filled in and well tamped. In fact, after

being filled in it remained idle all winter and the precipitation of rainfall of the past winter, amounting to over sixty inches, has made it more than safe to entrust the tamping to nature.

All further engineering details concerning the constructional features of this pipe line are presented in the accompanying table, which is a close approximation to accuracy. It begins the enumeration of the various sections at the power house and includes the pipe line up to the reservoir, and its respective sections are consecutively arranged according to the diameters and wall thicknesses of the different sizes of pipe used from the bottom up. The static pressure under the head of 1,195 feet is 518 pounds per square inch, and as the maximum working velocity of water in the pipe is ten feet per second, the effective head is 1,182 feet or a pressure of 512 pounds per square inch.

APPROXIMATE DATA OF THE STEEL PIPE LINE OF THE KILARC PLANT.

Section No.	Size of pipe.	Gradient.	Length in ft.	Total length.	Elevation above jet.
1	36x$^{13}/_{16}$	28°02′	248.80	248.80	125.33
2	36x¾	22°00′	76.14	.....	154.95
		11°11′	299.96	376.10	211.23
3	36x$^{11}/_{16}$	17°00′	227.63	.....	277.85
		13°15′	458.63	686.26	380.00
4	36x⅝	13°15′	118.00	.....	410.03
		4°45′	215.60	333.60	427.92
5	36x$^{9}/_{16}$	14°30′	249.38	.....	490.41
		11°30′	73.00	322.38	500.00
6	40x$^{9}/_{16}$	11°30′	224.50	.....	549.79
		4°30′	249.74	.....	569.47
		11°00′	125.74	.....	593.39
		4°00′	45.00	644.44	597.00
7	40x½	4°00′	161.70	.....	607.84
		19°50′	32.00	193.70	616.00
8	40x$^{7}/_{16}$	19°50′	217.53	217.53	690.00
9	42x$^{7}/_{16}$	19°50′	111.00	.....	730.24
		25°17′	75.00	186.00	750.00
10	42x⅜	25°17′	199.87	199.87	835.00
11	42x$^{5}/_{16}$	24°01′	200.00	200.00	925.00
12	42x¼	24°01′	150.34	150.34	1009.00
13	42x$^{5}/_{16}$	24°01′	224.23	224.23	1097.12
				3983.25	

Before proceeding to a description of the equipment of the power house it is well to give brief reference to the structural features of the buildings themselves. These buildings consist of a generator house and a transformer and switching house. They are of equal length, namely, 63 feet 4 inches, but the width of the generator house (Fig. 10) is 40 feet, while that of the transformer house (Fig. 11) is but 31 feet. Both are built of cement-laid rubble stone with 18-inch end walls and 30-inch side walls, and both have cement floors and corrugated iron roofs supported on steel angle iron trusses. There the resemblance practically ceases, however, for while the generator room is ceiled with galvanized corrugated iron

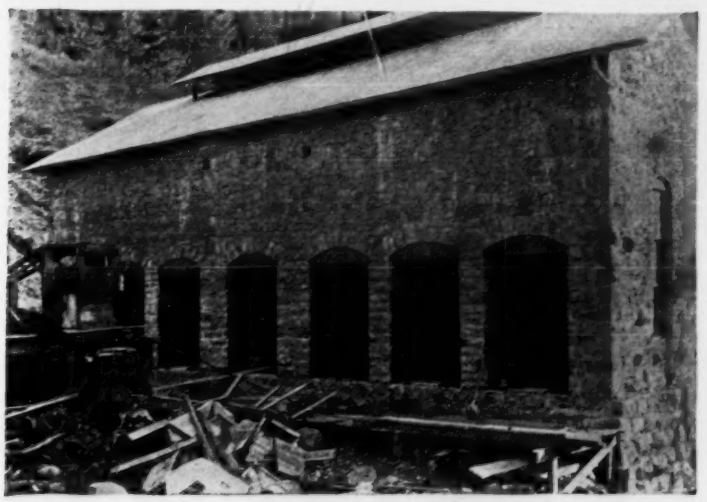


FIG. 11.—TRANSFORMER VAULTS, KILARC POWER PLANT.

laid flat up on the under side of the roof trusses, the other building is not ceiled at all. Moreover the transformer and switching building has a turret ventilator extending along the peak of the roof for almost its entire length, but the roof of the generator building is plain and unbroken. The generator room occupies the entire space of the building, but the transformer building is divided longitudinally by a stone wall 18 inches in thickness that extends through to the roof—even to the apex of the ventilator—so that it is a fire wall of most approved plan. This wall divides the building into two equal sections, the one alongside the power house being the high tension and switching section, and the one on the up-stream side of the building being the transformer section. A 3-foot door in the center of the floor line of the wall connects the sections, and on leaving the switching section, this door opens into a 9-foot passageway built into the transformer section at its center by the erection of 8-inch stone walls. Naturally the generator house occupies the down-stream position, and each of the two wheel sets which it contains has its own tail race which discharges in a direct line into Cow Creek. The building last referred to is spanned by a 15-ton chain-block crane supported on a ledge provided in the 30-inch side walls. Subways for cables and wiring are provided in the concrete floor, and the generator pits are specially drained into the tail race by means of hydraulic ejectors, but beyond the features stated, the generator building is without unusual innovation.

It is evident, however, that exceptional thought has been bestowed upon the structural features of the transformer and high

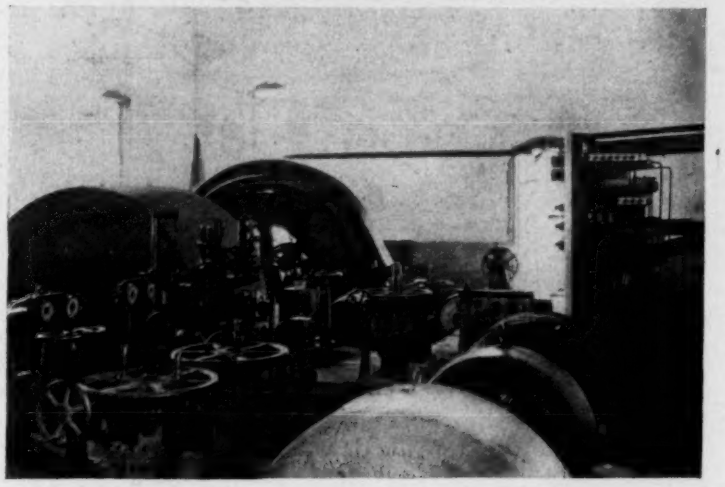


FIG. 12.—VIEW OF INTERIOR OF KILARC STATION.

tension switching building, for it is both unique and progressive in many important details. Its inside walls divide the building into practically four rooms, the largest of which, the switching room, extends the full length of the building by one-half its width. Six rectangular openings, each 3 feet in height by 2 feet 3 inches in width and 5 feet 5 inches between centers, and the bottoms of which are 13 feet above the floor line, are let into the dividing wall for the purpose of permitting the passage of two independent high-tension, three-phase circuits from the respective transformer banks to the high-tension switches, and at each end of the switching room are three 32-inch terra cotta sewer tiles built into the wall at a height of 13 feet above the floor line, for the purpose of permitting the egress of the two pole line circuits. These tiles are 3 feet 6 inches between centers and are closed in by plate glass.

The easterly or up-stream side of the transformer building contains seven 5-foot 8-inch doors, the center of which, while it forms the open end of the passageway closed in by the 8-inch stone walls and leading from the door to the switching room, contains the space transformer. The remaining doors form two sets of three each, with 8-foot centres, for the respective sets of step-up transformers. Thus each transformer may be taken from its section (they are permanently mounted on roller bases) and moved on to a sturdy little "go-cart" by means of which it may be trundled to the generator room where the crane becomes accessible for lifting the transformer from the case, if necessary. Ten-foot walls of 4-inch hollow tiling partition off each transformer from its neighbor, and beneath each transformer is a pit built in the concrete flooring by means of which any oil that may chance to leak may be collected and drained off to the outside of the section through either one of two 4-inch drains.

The cables from the switchboard in the generator room are led to the transformer section through a subway built beneath the floor of the switching room. This subway is 30 inches wide by 3 inches deep, and upon reaching the transformer section it branches laterally into two 18-inch ducts having a depth of 15 inches, which afford means for taking the cables to their respective transformers. The latter are of the oil-insulated and air-cooled variety, but the cooling of the oil is further effected by its forced circulation through a series of cooling pipe coils placed in the tail race of the little water-wheel that operates the oil pump. The details of this mechanism are to

be given later, but in describing the building it is pertinent to state that recesses are provided in the concrete work beneath the floor of the switching section for containing the tail race of the small wheel and the cooling coils referred to.

The power house, a partial view of the interior of which is shown in Fig. 12, contains two direct-coupled water-wheel and generator

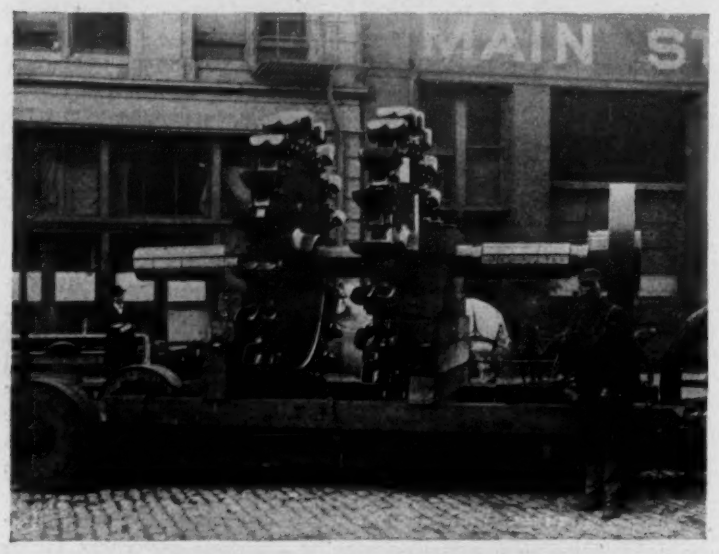


FIG. 13.—PELTON WATER-WHEEL BEING SHIPPED.

units, each of a normal capacity of 1,500 kilowatts, and to drive each of them there are installed two 1500-hp Pelton water-wheels enclosed in a single housing, thus making a double wheel unit of 3,000 hp. Water for their operation is taken from the main header through

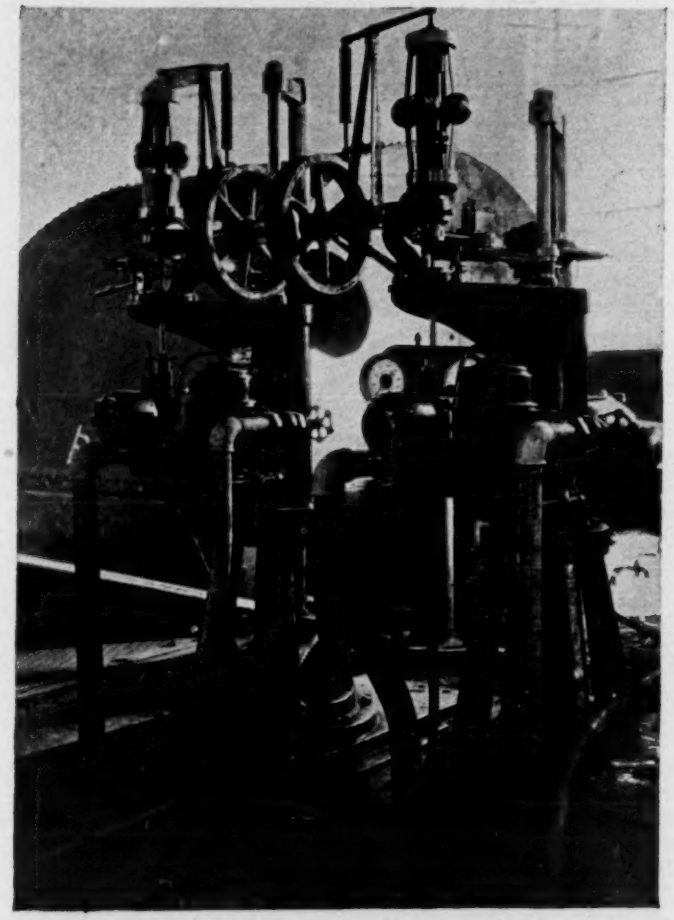


FIG. 14.—LOMBARD GOVERNORS AT KILARC.

separate 15-inch pipes, as stated, the pipes having ⅜-inch walls and each being provided with a specially heavy 14-inch Pelton gate valve that is operated by hand through a worm gearing. The nozzles have an outside diameter of 3 inches maximum, and are of the form that has become standard practice in double-wheel construction, namely, though each nozzle has its own gate valve, one nozzle consists of a simple open jet of the deflecting variety. The former, therefore, works in the wide open position at full load at all times when the generator is carrying more than 50 per cent. load, while regulation is effected through the manipulation of either or both the needle or the position of the latter.

But to revert to the wheels themselves and considering a single wheel of a double unit, each wheel carries twenty cast steel buckets supported by a plate steel disc, the two wheels of the unit being three feet between centers (see Fig. 13). The shaft has a diameter of 10½ inches which tapers to 9 inches in the bearings, and the units discharge into separate 8-foot tail races in the manner already described. The bearings are lubricated by oil under pressure and cooled by water circulation, drain pipes being provided in the outer shell to carry away any leakage that might occur into the tail race. The wheels operate at a speed of 300 revolutions per minute and each unit drives its generator through a flexible leather link coupling.

Regulation is effected in the manner outlined in generalities, but to be specific, hand regulation is used in controlling the position of the simple open deflecting nozzle, and hand regulation is used in controlling the position of the simple open deflecting nozzle, and

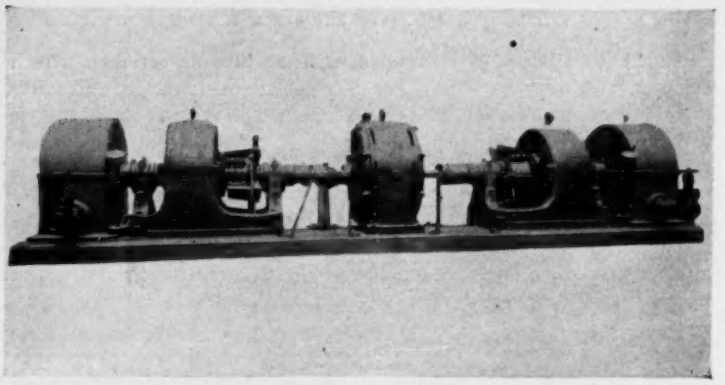


FIG. 15.—THEBERATH EXCITER COMBINATION SET.

hand regulation is used in controlling the position of the needle in the needle regulating nozzle, but the Lombard governor is used in raising or deflecting the needle nozzle. This Lombard governor (Fig. 14) is of the vertical type—"type Q"—and as such is of a form that is new to the power plants of the Pacific Coast. Its principles of operation are the same as those of former types, but it is specially advantageous in plants such as the one under description where limitations in ground space made it imperative that the utmost economy should be exercised in the use of apparatus requiring floor space. Water for the operation of the governors is taken from a living spring in a ravine a few hundred feet away and conveyed to the station in an independent pipe line under a head of about 90 feet, and as is common to all equipments now being installed by the Lombard Governor Company, the governors are under electrical control through the medium of push button plates placed on the main switchboard.

The exciter sets, which are two in number, are of the combination form devised by the late Mr. T. E. Theberath and as installed by him in the original Colgate plant of the Bay Counties Power Company. Each set consists of a 45-kw, 125-volt, direct-current Westinghouse generator, a 60-hp, three-phase, 2,200-volt, "type C" Westinghouse induction motor of 60 hp, and a 34-inch Pelton water-wheel lined up and coupled together through flexible couplings as on a common shaft, which runs at a speed of 850 r.p.m. (Fig. 15.) This arrangement has become such a universal practice, in one form or another, however, that to point out its many inestimable advantages at this late date would be redundant. The equipment possesses one new and original feature, however, and that rests in the use of a push button switch for controlling the exciter water-wheel after the manner in which the Lombard governor is handled from the switchboard.

Two two-button push-button plates, one for each exciter water-wheel, are placed on the exciter panel of the main switchboard immediately below the handles for the respective rheostats. The neutral point of these push button contacts connects to the negative

bus-bar of the exciters, and by actuating one or the other of the pushes, negative current may be thrown on to either half of the fields of a small 125-volt, series wound, direct current motor that is mounted on the side of the exciter wheel housing. This motor, which has a rating of 1-6 hp, is, as stated, series wound, the positive lead entering at one brush while the other brush is connected to the middle point of its field winding so that as negative current is sent to one or the other of its field halves, rotation is accomplished in either direction with one-half the normal field. In series with the positive lead is a magnetic brake bearing upon a friction pulley placed on the motor shaft and by means of which the brake is released when the circuit is closed by either push button. To particularize further, the motor runs at a speed of 1,500 r.p.m. and its

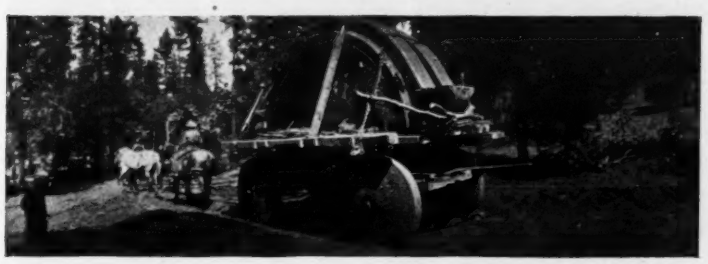


FIG. 16.—ARMATURE FOR 1500-KW GENERATOR EN ROUTE TO KILARC.

extended shaft has a ⅞-inch worm with 20 threads per inch, which engages with a worm wheel that is 7 inches in diameter, and similarly has 20 threads per inch in 500 teeth. A vertical shaft that is provided with a hand wheel at the top to permit of manual operation, is driven by this 7-inch wheel through the intervention of a rack and pinion, and this vertical rod swings a lever with a radius of 6¾ inches which connects to the rocker shaft that deflects the nozzle on or off the buckets of the exciter wheel as necessary. Top and bottom contacts placed on the rod at the ends of the respective upward and downward runs cut out the motor when the limits are reached by opening the circuits leading from the respective push buttons. The operation of the arrangement is simple and wonderfully effective. As an auxiliary, connections are provided for the operation of the mechanism direct from an automatic voltage controller to be placed on the exciter circuits, but as yet this combination has not been installed although its addition has been determined upon.

As implied, the generators are two in number and run at a speed of 300 r.p.m. Each has a rated capacity of 1,500 kw and is of the Westinghouse, star-connected revolving-field type, delivering three-phase current at 60 cycles per second. No reference need, therefore, be made to their particular features which are well known, but as they weigh some 79,000 pounds each, and as their largest single casting weighs 28,000 pounds, it was not so simple a matter to transport them to the power house over thirty odd miles of mountain road as it is to read about it. The accompanying Fig 16 shows how the armature frames were mounted for their freighting. The wheels of the cart shown are sections cut from six-foot pine logs hewed to a rounded convex surface on the sides and tired with 10-inch welded wrought-iron rings. The brake, which may be dimly seen in the original photograph under the bed of the wagon, covers some four feet of the periphery of each of the rear wheels, and trailing out horizontally from the axle behind is the brake lever. That this device often proves to be ineffective is demonstrated by the fact that all along the road trees are seen at the tops of hills, bearing the mutilations of the "snubbing" ropes which were lashed about them and paid out by slow slipping as the wagon was gradually lowered down the hill. In going up grades, the block and tackle was perforce all too frequently used, and to further emphasize the difficulties under which such heavy pieces of machinery are freighted in Sierran foothills, it may be stated, with maledictions upon the bend in the road that prevents its showing, that 28 horses were hitched up to the load there illustrated.

The generating station contains three switchboards, namely, the main switchboard, placed opposite the Lombard governors facing the center of the station with back toward the easterly wall, and an auxiliary and an emergency switchboard placed one on either side of the main entrance to the station. These latter boards will be the subject of more specific treatment, for consideration will first be given to the main switchboard which consists of four panels of white Italian marble. Panel No. 1 controls the two direct-current machines of the exciter combinations as well as the water-wheels. It contains first two direct-current ammeters and a direct-current voltmeter with plug switch for indication of the output of the respective exciters. Then follow the field rheostats and the two push-button plates for the electrical control of the exciter wheels. Two triple-pole, double-throw knife switches connect the exciters with either of the two sets of exciter bus-bars as well as with the equalizer; a double-pole, double-throw knife switch serves to connect either bus-bar with the auxiliary switchboard; a double-pole, single-

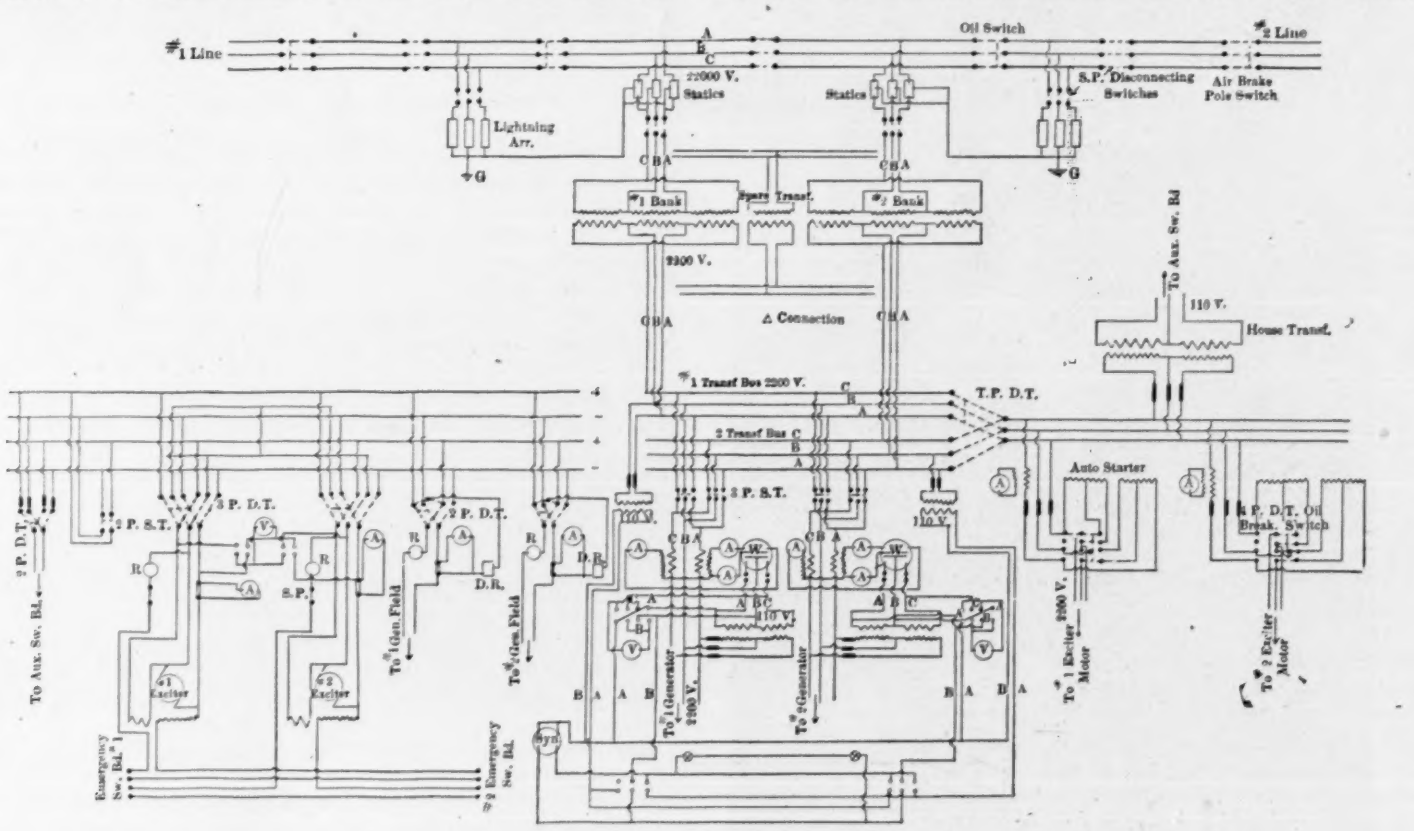


FIG. 17.—GENERAL DIAGRAM OF CIRCUITS OF KILARC PLANT.

throw knife switch is used for paralleling the bus-bars, and outlets are provided for the connection of the shunt fields to both sets of emergency switchboards at some future time.

Panels Nos. 2 and 3 are duplicate panels used for the control of generators Nos. 1 and 2, as well as for the control of the Lombard governors of the respective wheels. Each contains, therefore, three indicating voltmeters, one for each phase; an indicating ammeter with phasing plug switch; a three-phase wattmeter, the voltage coils of which are commutated by means of a switch specially designed for this purpose; a direct-current ammeter reading to 200 amperes for the field circuit; a rheostat in series with the field circuit; a two-button push-button plate switch for controlling the Lombard governor; a double-throw, double-pole knife switch for connecting the field to either exciter bus; and two three-pole, single-throw oil switches by means of which the output of the generator may be thrown to either of the two sets of transformer busses.

Panel No. 4 is unique. It controls not only the auto-converters for starting the induction motors used in the exciter combination sets, but also carries switches for actuating the high-tension break switches that are in the switching section of the adjoining building as shown diagrammatically in Fig. 20. Moreover the auxiliary storage battery used in conjunction with these switches is charged through switches contained thereon, as are also tell-tale incandescent lamps in red and blue colors for showing which of the high-tension bus-bars of the adjoining building are alive. An indicating ammeter placed in one leg of each three-phase circuit leading to an induction motor gives the current consumed thereby, and in addition the transformer supplying current on the three-wire system at 110 volts to the side is controlled therefrom. Behind the panel runs a single set of bus-bars which may be coupled on to either set of 2,200-volt busses through the medium of a three-pole, double-throw oil switch. Each induction motor is started by the manipulation of a four-pole, double-throw, oil-break switch that is combined with its auto-converter in a single oil tank—the combination being termed an "oil-break auto-starter" switch. Card holders are also provided on this panel for labelling various devices, and it is tapped for two controller switches and indicators, to be used in conjunction with the system of automatic electrical control that is to be placed on the motor which handles the nozzle of the exciter wheel. All instruments and appliances used about the plant are of standard forms as produced by the Westinghouse Electric & Manufacturing Com-

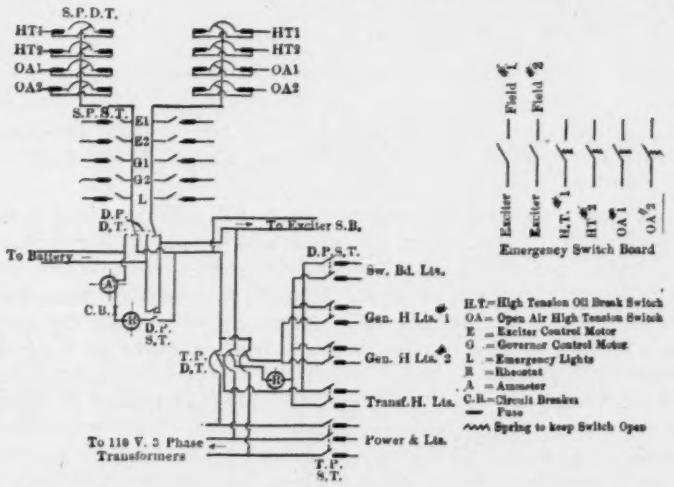


FIG. 18.—AUXILIARY AND EMERGENCY SWITCHBOARD.

pany, unless otherwise specified, and as such they require no detailed description. Furthermore, the various main circuit combinations into which they are worked and as just outlined, are diagrammatically shown in Fig. 17 herewith, where it is shown that the two sections of the high-tension wiring in the transformer building are paralleled by means of a set of M-T open-air switches, which may be tripped open from the main switchboard or from either the auxiliary or the emergency switchboard in the manner soon to be described. This tripping device is under the control of a solenoid, and signal lamps placed on Panel No. 4 indicate whether the M-T switches are closed or open.

It is in a somewhat similar manner that the main high-tension Westinghouse 35,000-volt switches are actuated, for they, too, are controlled from either of the three points named, but while they are closed by the direct pull of a solenoid, they are opened by a trigger that is released by a tripping magnet. The installation is the first of the high-tension remote control which the Westinghouse Company has made in California, and though it works perfectly in practice, it subjects the exciters to a load of 40 amperes or so, to overcome which a storage battery is being installed. As in the

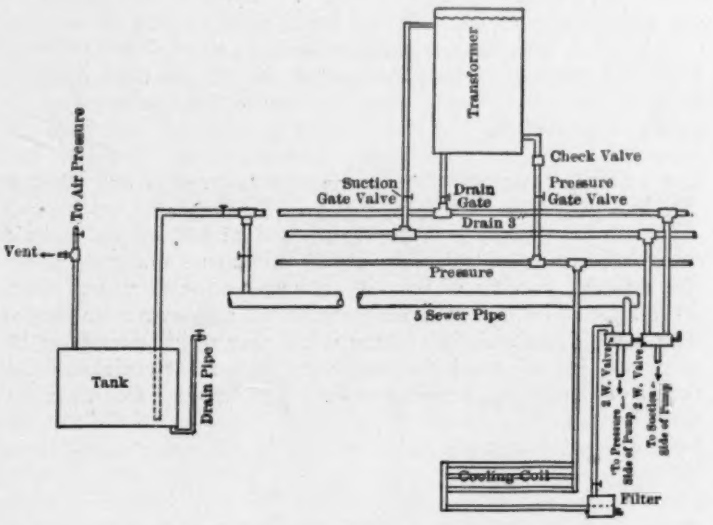


FIG. 19.—TRANSFORMER COOLING AND DRAIN SYSTEM.

previous instance, tell-tale indicators placed on the main switchboard show the position of these switches.

The emergency and auxiliary switchboard, the circuits of which are shown in Fig. 18, embody features which, so far as the writer is aware, are not to be found in any switchboard practice elsewhere. The emergency board will never be used except in case of fire, or of breaking of the pipe line, or of some other untoward accident that will enforce all possible haste in leaving the buildings, in which event the location of the emergency switchboard on the inner wall of the generator building right adjoining the main entrance, makes it possible to disconnect the entire electrical service by a single instantaneous motion. To the emergency board are brought a series leg of both exciter shunt fields, a contact in multiple with both controlling circuits for both open-air, high-tension break switches—all being in connection with the corresponding devices on the main switchboard. There are, then, six switches on the emergency board, namely, two exciter field switches, two oil-break switches, and two high-tension switches, and though they may be separately actuated, they may be handled as a gang. The arrangement is shown diagrammatically in Fig. 18.

The auxiliary switchboard is less simple than the emergency board, although its originality is equally marked. It has not been installed as yet for the reason that it is not necessary to operation, hence it has been thought best to postpone its erection until other work more essential to the operation of the plant has been completed. In point of fact, the auxiliary switchboard is merely a time-saving convenience, though conditions will arise from time to time when its presence will enable it to be of great utility. It, too, is to be located near the main entrance, and like the emergency board it is to be mounted on a single marble panel of standard specifications.

Fig. 18 also gives a diagrammatic outline of the connections of the auxiliary switchboard, wherein it appears that current for actuating the various switches may be taken from either the battery or the exciter switchboard, while current for the operation of the local power and incandescent lighting service may be taken either from the exciter switchboard or from 110-volt transformers in three-phase connection. All electrically operated switches and controlling devices about the plant may be manifested therefrom, while from the lighting and power section of the board the lights are operated in four circuits, namely, the switchboards, the transformer building and two circuits in the generator building. Or, if desired, all the lights may be operated in conjunction with the power from a set of three 110-volt transformers in three-phase connection, in which event the voltage of the lighting circuits is regulated by a rheostat placed in one leg of the three-phase circuit. Moreover the board carries an ammeter and rheostat with excess current circuit-breaker and

switch, by means of which the storage battery may be charged from the exciter switchboard. It is the intention, however, that this switchboard shall be normally inoperative.

Passing to the adjoining building, the first feature which attracts attention, in addition to those already considered, is the setting of the transformers which are shod, so to speak, with a framework of oak bearing on two 6-inch channel irons each some six feet long. In line with these channel irons are two others of similar size but which are nearly 11 feet long, the latter being let into the concrete of the transformer section of the building so as to form rails upon which the transformer cases may be run through the intervention of flanged, cast-iron rollers. These rails are placed transverse to the length of the building and they continue out through each respective transformer opening to the platform where, in case of repair, they may be loaded upon the "go-cart" before referred to and taken to the shop.

Though the transformers are of the standard oil-insulated and air-cooled type as manufactured by the Westinghouse Company, it was thought best, in view of the high atmospheric temperatures which prevail for months during the summer, to supplement air cooling with a positive circulation of the oil, during which circulation the oil would be subjected to cooling by water. The diagrammatic sketch of the piping connections for the oil cooling and drain system, shown as Fig. 19, facilitates an understanding of the arrangement adopted and installed. A 12-inch Pelton water-wheel, driven by water taken from the main pipe line, operates a centrifugal oil pump which has a suction pipe 4 inches in outside diameter. Within the tail race of this water-wheel is placed the cooling coil consisting of two 32-inch headers each 4 inches in diameter, into which are connected ten 1-inch galvanized iron water pipes so as to form a grid. There are two such grids installed, one above the other, and through them in series the oil is circulated and cooled.

The arrangement of the piping therefore, though apparently intricate, is simple. As heated oil rises to the top of the transformer case, the suction pipe is connected thereto through a gate valve which opens into a suction header that passes the full length of the transformer house so as to pass by all transformers. Similarly the length of the transformer house is traversed by a drain header, a pressure header, and a 5-inch iron sewer that is used as a waste pipe in forcing the oil under pressure well away from the building and tank in case of an emergency. Both pressure and suction sides of the pump are furnished with two-way valves; that for the pressure side throwing the oil into either the sewer pipe or the pressure header through the cooling coil, and that for the suction side drawing the oil from either the drain header or the suction header. Connection is also made from the side of each transformer case near the bottom to the pressure header by means of a 2-inch pipe with a gate and check valve; from the transformer case to the drain header by a 2-inch gate valve and pipe, the latter being tapped into the bottom of the case; and the sewer pipe is connected to the drain header through a 3-inch pipe and gate valve. The diameters of these headers are: Drain, 3 inches; suction, 2½ inches; pressure, 2½ inches.

As to the *modus operandi*: At the outset the storage tank is filled with oil, the drain gates beneath the transformers are closed, as are also the suction gates, the pressure gates are opened, the gate valve connecting the drain header to the pipe leading to the bottom of the storage tank is opened, the two-way valve connecting the suction side of the pump is opened to the pressure header after passing through the filter and cooling coil respectively. Under this combination, oil is lifted from the storage tank into the transformer cases. When the latter are filled, close the gate valve between the drain header and the storage tank, throw the two-way valve on the suction side of the pump to the suction header, open the suction gates leading to the tops of the transformer cases, and the heated oil from the transformer cases will be circulated through the oil filter and cooling coil and returned to the transformers near the bottoms of their cases. If it be desired to draw the oil from any transformer case, close its suction and pressure valves, open its drain valve and the valve connecting the drain header to the storage tank, when the oil will flow into the tank by gravity. If emergency should require that the cases be emptied in the shortest possible interval of time, close the valves connecting the drain header with the storage tank and with the sewer pipe, throw the two-way valve on the suction side of the pump to the drain header and the two-way valve on the pressure side of the pump to the sewer pipe, when the drain header will become a suction pipe under vacuum and the oil will be discharged into the sewer pipe at a rate that will empty any transformer case of its oil in less than two minutes. As stated heretofore, all these piping accessories to the oil cooling system are laid under the concrete floor of the high-tension switching section of the transformer building, but the water-wheel and oil pump occupy a concrete foundation built up against the dividing wall which separates the transformer and switching sections. The different headers referred to are, of course, laid in a subway extending throughout the length of the transformer section.

It is a peculiar incident that the Kilarc power house is almost absolutely due north of the power house at Volta, the difference between them being only a few minutes of longitude. Their separation in this due north and south line is 14.6 miles, and although the transmission lines connecting Kilarc with Palo Cedro by way of De La Mar has been finished and is in operation, supplying current at 25,000 volts for such use as may be required in and about the Kilarc station, the trunk line connecting the two plants has not been constructed as yet. Nevertheless every provision is being made for its construction so far as the Kilarc end of the trunk is concerned, and to accommodate this condition the high-tension wiring of the switching section of the transformer building at Kilarc is divided into two sections, the northerly and southerly sections,

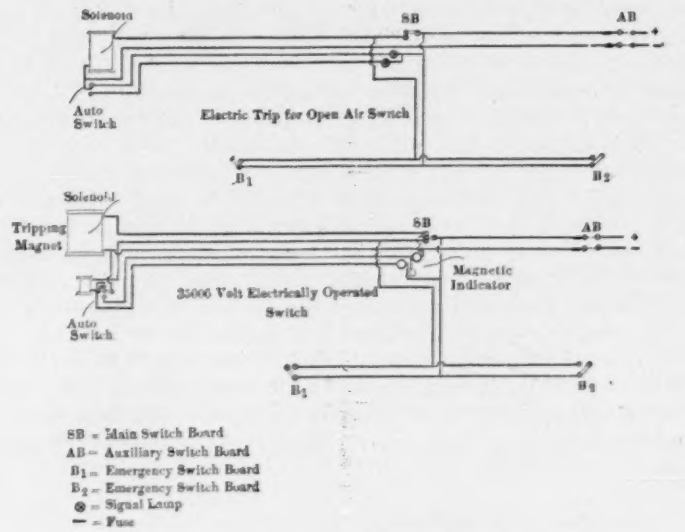


FIG. 20.—ELECTRICALLY OPERATED HIGH-TENSION SWITCH.

and through the respective end walls of the building the high-tension transmission lines emerge by way of 32-inch sewer tilings as previously described.

The seven high-tension transformers are divided into two banks of three each, there being one spare transformer which occupies the central one of the seven transformer compartments. These two transformer banks are, of course, supplied by separate busses leading from the main switchboard as already shown, while the spare transformer may be connected in on any leg of either bank on either the high or low sides by means of the special switches which are provided for the purpose (Fig. 20). The high-tension switching arrangements provide for the complete isolation of any transformer or piece of apparatus; the two transmission lines may be operated separately or in parallel; either bank of lightning arresters may be cut out of service and, in brief, the entire arrangement is characterized by remarkable flexibility—which is but another expression for conveying the idea that in event of trouble every possible provision has been made to facilitate the resumption of service with a minimum of delay. At present the plant is to be operated in parallel with the Volta station at 25,000 volts in delta connection on both sides of the transformers, but after the load increases, the transformers of both stations will be star connected, which will result in the delivery of 38,000 volts to line.

A further innovation is embodied in the constructional features of a pole switch that has been designed for use in handling the high-tension switches. It consists merely of a pole of oak, 1½ inches in diameter, the continuity of which is broken in the center by the insertion of two 10,000-volt porcelain insulators.

Design of Armature Coils.

Innumerable formulas are available for determining the electrical design of the armatures of direct-current machines, but few reliable equations can be found which treat of the mechanical form of the coils. The formulas given below are intended for use after the electrical design of the machine has been completed, and they serve for designating the proper shape to be given the coils in order most economically to employ the space at the end of the core. It is assumed that all work is completed except the final shaping of the coils, so that they may properly overlap.

Referring to the accompanying figures, the following notation will be used:

A = developed arc of radius, D (Fig. 1),
B = scaled distance obtained from Fig. 1,
C_1 = clearance between coils, (see formula 5),
C_2 = clearance between bundles (see formula 8),
D_1 = diameter of armature at center of upper coil,
D_2 = diameter of armature at bottom of upper coil,
D_3 = diameter of armature at bottom of lower coil,
E = radius (see Fig. 1),
G = constant (taken as ⅜ in.),
H = constant, subject to alteration; for armature under 12 in., H = ⅜ in.; over 12 in., H = ½ in.;
K = constant for enlarging scale (say 10),
M = total number of coils, including dead coils, if any are present;
N = total number of slots or bundles of coils,
P = teeth included by each coil, or throw of coil minus 1;
T = thickness of coil wire, insulated (wire winding), or
T = thickness of bundle-copper, bare (ribbon winding);
$r = \frac{T}{2} + \frac{1}{4}$ in. (see Fig. 2),
W_1 = over-all thickness of coil, including its pro rata of bundle wrapping, outside of slot;
W_2 = over-all thickness of bundle outside of slot,
X and Y = available spaces for coil ends (see Fig. 1),
β = coil span from center to center of slots,
$\Theta = \beta/2$ angular measurement (see Fig. 1).

From the above and by use of Fig. 1 the following equations can be developed:

$$\Theta = \frac{360\ P}{2N} \quad (1)$$

$$A = \frac{D_1\ \pi\ \Theta}{360} \quad (2)$$

$$X = \frac{D_2\ \pi\ K}{M} \quad (3)$$

$$Y = \frac{D_3\ \pi\ K}{M} \quad (4)$$

$$E = (W_1 + C_1)K \quad (5)$$

$$X = \frac{D_2\ \pi\ K}{M} \quad (6)$$

$$Y = \frac{D_3\ \pi\ K}{N} \quad (7)$$

$$E = (W_2 + C_2)\ K \quad (8)$$

For wire windings, formulas (3), (4) and (5) are used; for ribbon winding, formulas (6), (7) and (8).

The formulas given are applied in the design of coil forms, according to the following process: Draw preliminary end elevation, as seen in Fig. 1, under the assumption that $\Theta = \beta/2$, as stated. Then lay out a diagram of the developed plan (Fig. 1) with the help of the formulas. Strike arcs r, r (Fig. 2) from points shown and make b and b parallel to a and a, to locate the point d, on which, as a center, construct the half turn (or bundle). For ribbon coils the half turn will be radial to shaft, as shown in Figs. 1 and 2. For wire coils the half turn will be oblique (Fig. 3). The angle of obliquity is determined by trial, by tracing two adjacent coils (or bundles), allowing minimum clearance of .10 in. for armatures of 10 in. diameter and smaller, and .15 in. for larger armatures.

Complete the end elevation and project to the plan view, joining the active conductor to end connections by arcs of ¼ in. radius. After d in Fig. 2 is located, project it to end elevation to find true location of half turn. Project upper and lower legs of coil from end elevation and complete plan view, as per Fig. 4.

Formers for wire coils are laid out for individual coils, with winding space sufficient for insulated wires, omitting varnish and bundle

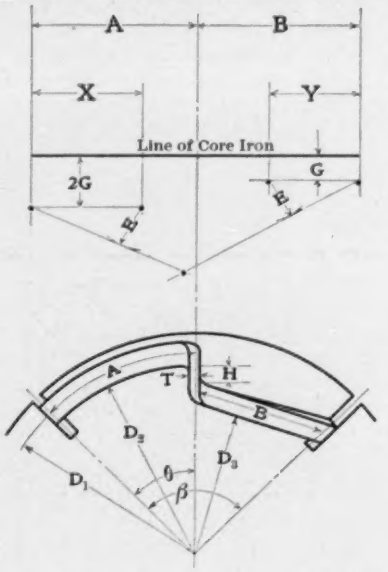


FIG. 1.—DEVELOPMENT OF COIL SPACE AND COIL IN PLACE ON ARMATURE.

insulation, but allowance is made for all insulation and varnish in figuring the end clearance. Formers for ribbon coils are laid out for bundles with winding space for bare copper only. Bundles are

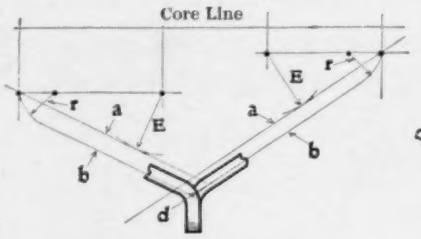


FIG. 2.—RADIAL HALF TURN FOR RIBBON COIL.

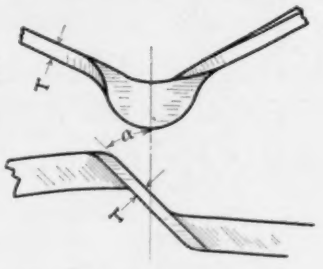


FIG. 3.—OBLIQUE HALF TURN FOR WIRE COIL.

figured for clearance with all insulation and varnish allowance.

The insulation and clearance allowed for armature coils on the section outside of slots is: varnish on wire, add .003 in. to diameter; tape on coil, .006 in. per layer; varnish on coil, .004 in.; double

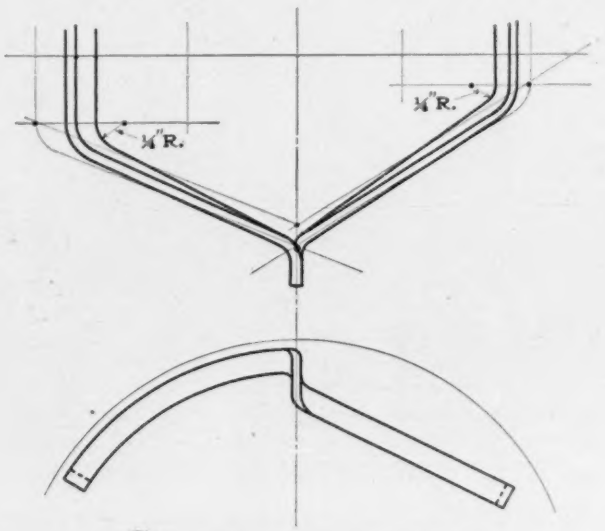


FIG. 4.—PLAN VIEW OF RIBBON COIL.

thickness of varnished tape overlapping one-half, .04 in. for both sides of the bundle. The clearance between bundles for armatures under 12 in. diameter, .02 in. for one coil, .025 in. for two coils, and .03 in. for three coils. For larger armatures the corresponding values would be .03 in. for one coil, .035 in. for two coils and .03 in. for three coils.

German Electrical Exhibits at the World's Fair.—III.

By Frank Welz.

THE following sets of apparatus serve for the testing of iron and steel as to their magnetic qualities by means of samples of a certain size and form. One of the exhibited arrangements, the connection of which is shown in Fig. 11, gives,

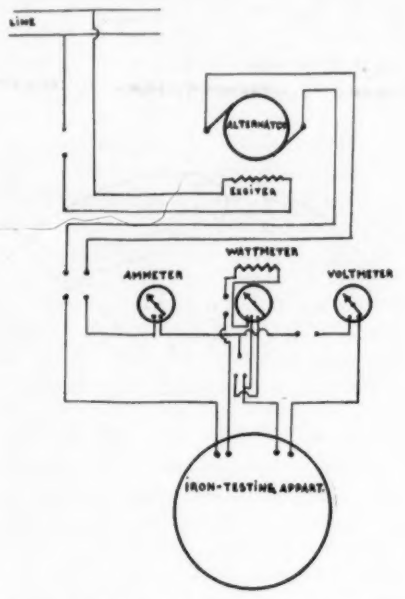
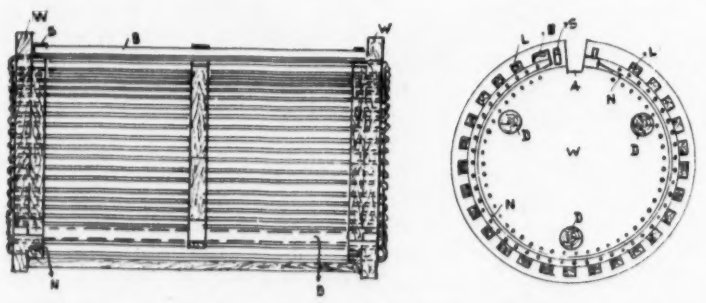


FIG. 11.—SIEMENS & HALSKE IRON TESTING APPARATUS.

through the deflection of a needle, the magnetic induction per sq. cm. of the sample to be tested, employing the Deprez-d'Arsonval type of measuring instrument. The sample, bridging over the poles of an electro-magnet, is enclosed by a magnetizing coil. A coil swings in a small air gap of this yoke and a current of known value flows through it. The deflection of this coil is proportional to the magnetic induction which is indicated in direct values on the scale. For magnetic tests of higher accuracy the Siemens & Halske Co. has on exhibition a magnetic precision balance according to Du Bois. The magnetizing coil, which surrounds the sheets or bars to be tested, possesses a correction winding and the heavy yoke-piece of cast steel of high permeability forms the arm of a balance. The magnetic attraction is compensated by a running weight, the displacement of which gives the measure of the induction obtained. In order to avoid the waste of time and material in using samples for the magnetic tests, the Siemens & Halske Co. has built an apparatus allowing the testing of entire steel sheets as they come from the works. This apparatus is illustrated by Figs. 12 and 13, also at the right in Fig. 9 (last issue). It is built in



FIGS. 12 AND 13.—SIEMENS & HALSKE IRON TESTING APPARATUS.

the shape of a drum, the advantage being that the iron sheets can be put in with hardly any deformation and this also gives the most favorable distribution of the lines of magnetic force, the sheets being bent to the surface of a cylinder and surrounded on the whole circumference by the windings. Another advantage of this cylindric form is that the apparatus can be rolled easily from one place to another and the tests can even be directly carried on in the iron storeroom. The sidewalls *W* are fastened together by heavy bolts *D* and bear the grooves *N* which serve as guides for the sheets pushed into the apparatus at *A*. The beams *A* are movable, being lifted for the entrance of the sheets and pressed down after the sheets are jointed together preventing the sheet ends from jumping out. The windings consist of bare copper wires and are strung between the sidewalls *W*, the slats *L* protecting them from damage. The winding is split up into two sections which can be connected either in multiple or in series, making it possible to use either the single or double voltage. This is of special advantage if the sheets are to tested for different magnetic inductions. This construction of the apparatus allows the use of only one size of sheet and it is therefore necessary to build a special apparatus for each size. But this disadvantage is of no great importance if the simplicity of the apparatus is taken into consideration, especially since only two standard sizes of sheets are hereafter to be used in Germany for electrical purposes, according to the last proceedings of the "Verband Deutscher Elektrotechniker." On account of the fact that the dial of the wattmeter can be utilized only at the maximum current and that the voltage on the instrument can easily be adjusted to its most favorable value, the apparatus for different sized sheets is built so that the current is constant for all of them. The voltage changes in proportion to the surface of the sheets. It is possible to test with this apparatus four sheets of 0.5 mm. thickness or six sheets of 0.35 mm. thickness at a time without any difficulty in insertion, giving the results correct within the allowable limits. Special attention must be given to the joints, and the best results have been obtained by overlapping the sheets, using for this purpose 1 per cent. of the length of the sheets, without employing any extra iron parts. For commercial tests, it is not necessary to insulate the sheets from each other, and only on the edges paper caps of ½ in. width are put over the sheets. The commercial tests give values for the iron loss which are about 3 per cent. too high,

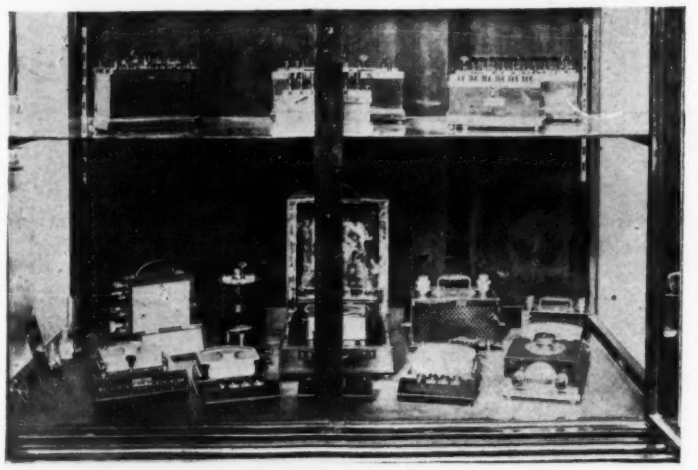


FIG. 14.—SIEMENS & HALSKE INSTRUMENTS OF PRECISION.

and by deducting this we obtain the absolute value. As all the methods for determining iron losses, known at the present time, are rather imperfect, it has been deemed wise not to require too high an accuracy of this apparatus, but rather to place more importance upon the condition that these tests have to be made in the shortest possible time and that even an unskilled operator can handle this apparatus.

The next section shows an apparatus for the reproduction of the wave form of an alternating current—a so-called oscillograph. This apparatus is built according to the principles as worked out by Blondel, but the Siemens & Halske Co. has made some considerable improvements on it, so that it suits the purpose in the most perfect manner. By means of a clever device, the diagram is made visible just the moment before it is to be photographed and the experimenter is therefore enabled to choose that part of the wave which is specially interesting to him. The oscillograph is in its principle a galvanometer, the movable parts of which are reduced to the minimum of practical size. The light beam which follows the electrical oscillations in accordance with the wave form is thrown on a drum covered with photographic paper. The drum is put in rotation by a synchronous motor which drives at the same time the device for making the curve visible. A mirror is placed between the oscillograph and the photographic drum which throws the light first upon the above mentioned device and so makes the curve visible before being photographed. On pushing

a button the mirror springs back, and the light beam writes on the photographic paper.

The next section contains a series of apparatus for pyrometric measurements. In these instruments thermo-elements of copper-konstantan are used for temperatures from minus 190 degrees Cels. to plus 600 degrees Cels.; for higher temperatures up to 1,600 degrees Cels. thermo-elements of platinum and platinum-rhodium, according to Le Chatelier, are employed. Besides a registering pyrometer, the most interesting piece of apparatus in this section, is an arrangement for exact pyrometric measurements according to Professor Lindeck. The principle of this arrangement is that an adjustable potential difference, the value of which is known at any time, is connected up against the unknown e.m.f. of the thermo-element. This method is employed with advantage in all cases where the common method of testing thermo-elements by means of a galvanometer, calibrated for voltage, is insufficient on account of its inferior accuracy.

In the second group of the Siemens & Halske exhibit is found a series of precision instruments for direct current (Fig. 14) built according to the principles indicated by Lord Kelvin and Deprez-d'Arsonval and perfected by Weston. Under these we find a precision millivolt and ammeter of 1 ohm resistance for 0 to 0.05 amperes and 0 to 0.15 volts, together with the necessary shunt and series resistances for multiplying the voltage scale. In this connection is used with great advantage a shunt resistance of Pro-

FIG. 15.—SIEMENS & HALSKE UNIVERSAL GALVANOMETER, OHMMETER AND UNIVERSAL BRIDGE MEASURING SET.

fessor Feussner, which allows the use of the millivoltmeter as a multiscaled ammeter and enables the operator to switch from one scale to either one of the other seven or to the short circuited position without interruption of the current during the reading. There is seen also a combined precision volt and ammeter for simultaneous reading of current and voltage. The two instruments are without temperature coefficient and mounted together on a hard rubber plate. There are four voltage ranges for 3,150, 300 and 600 volts and also four current scales for 3, 7.5, 15 and 30 amperes. Besides these the instrument contains a device for the connection of special shunts. Besides a number of the simpler types of instruments this exhibit contains a "Universal galvanometer" (Fig. 15) which is a combination of the Deprez-d'Arsonval instrument and a Wheatstone bridge and allows the direct measuring of current, voltage, e.m.f.'s, wire and battery resistances up to 30,000 ohms and the locating of faults in cables and aerial wires. This instrument has found an extension of its field of application inasmuch as the bridge can also be used with alternating current for the determination of electrolytic resistances, using the telephone as a zero instrument. For exact tests, if the effective values of current, voltage and power have to be determined independently from the frequency and the wave form, the Siemens & Halske Co. has successfully utilized in its instruments the electrodynamic principle by which the current passes through a coil which is rotating in the almost homogenous field of a stationary coil. The cases of these instruments are made of wood in order to avoid eddy currents, and the air damping makes the instrument almost aperiodic. According to the connection of the coils either an ammeter, voltmeter or wattmeter results, one of each being on exhibit. For measurement of alternating current the Siemens & Halske Co. also recently put on the market an instrument built on the induction principle as indicated by Ferraris. Of these so-called "rotating field measuring instruments" we find of the portable type a wattmeter, ammeter and voltmeter (Fig. 16) and also one of each kind of these instru-

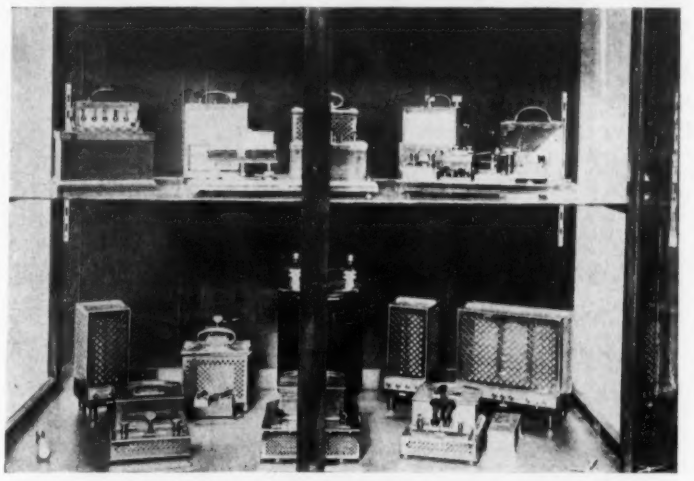


FIG. 16.—SIEMENS & HALSKE INSTRUMENTS OF PRECISION.

ments of the electromagnetic type. In this latter type a core of soft iron is pulled into a coil. Constructed after the same principles and simply adapted for the special purpose, this company shows different types of instruments for the testing of insulation in high and low tension installations. These tests are made either with the aid of a battery, if no current is available, or with the service voltage if the mains are alive, or if the installation is to be tested in service.

The next section contains in a special showcase a collection of galvanometers, electrodynamometers and electrometers with mirrors. A mirror galvanometer of the Deprez-d'Arsonval type is shown wherein a movable coil swings in a strong magnetic field. The principal advantage of this arrangement is that, as the coil is swinging in a homogeneous magnetic field, the deflections of the mirror are proportional to the current, within a wide range. The swinging coils are easily exchangeable, which last makes it possible to adapt very advantageously the moving system to the required measurement, leaving the rest of the instrument unchanged. The

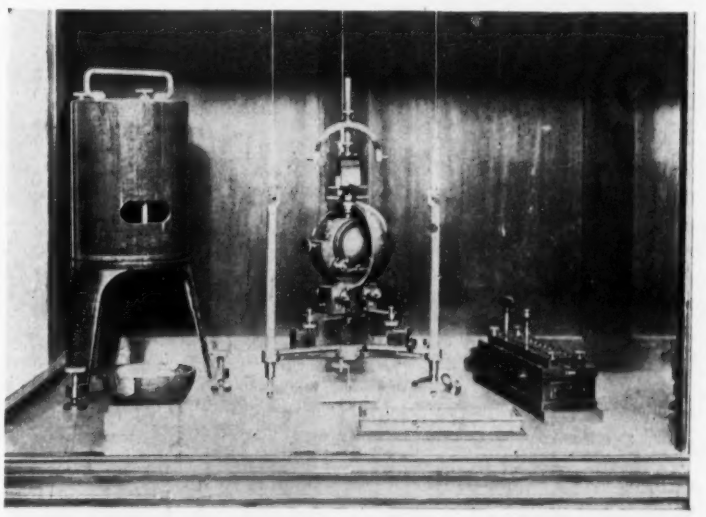


FIG. 17.—MAGNETICALLY SHIELDED GALVANOMETER, SIEMENS & HALSKE EXHIBIT.

movable coil possesses a damping winding and, by means of a magnetic shunt, the sensibility of the instrument can be varied at will within 35 per cent. The magnetically shielded galvanometer of Du Bois and Rubens (see Fig. 17) involves the opposite principle from the former. In this needle galvanometer the winding is stationary and the magnet system movable. It contains two concentric spherical

shields and a third cylindrical shield which serves at the same time as a case of transporting the instrument. This device gives to the instrument a 1,000-fold protection from exterior magnetic disturbances and it can be used specially for scientific tests in cases when strong exterior magnetic fields exist, as for instance from electric streets cars, etc., or when the sensibility of the Deprez-d'Arsonval mirror galvanometer is not sufficient. For very exact work these galvanometers are suspended on a special device which has the effect of keeping the instrument free from outside vibrations.

For the measuring of small alternating currents, the Siemens & Halske Co. exhibits a mirror electrodynomometer (seen at the right in Fig. 18) not influenced by eddy currents. Special care has been taken in constructing this instrument to avoid all metallic parts as far as they are not absolutely necessary for carrying the

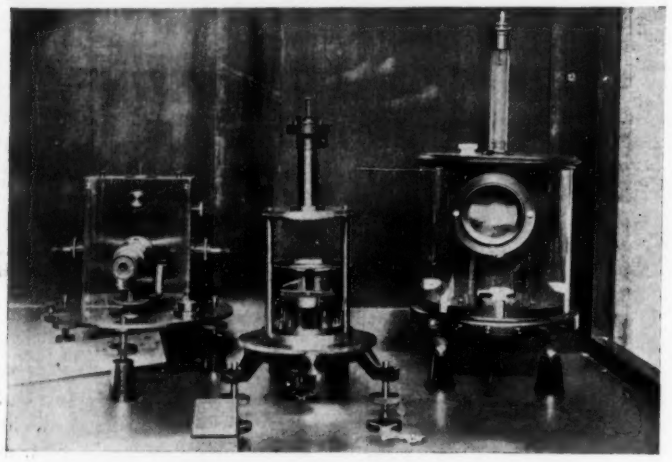


FIG. 18.—ELECTROMETER, QUADRANT ELECTROMETER AND MIRROR ELECTRODYNAMOMETER, SIEMENS & HALSKE EXHIBIT.

current. This instrument, which is entirely free from the effects of eddy currents, can be used for accurate measurements of electrical energy with or without a phase difference. It possesses a strong air-damping arrangement, which is also made of non-conducting material. Finally this case contains an electrometer of Beggerow (see Fig. 18 at the left) with two adjustable electrodes and a movable needle, consisting of a very thin metallic band of very small capacity. The reading is taken by means of a microscope and an ocular-micrometer. The instrument is enclosed in a metallic box and the insulating material consists of amber and crystalized quartz. The air in this box is dried by means of metallic sodium. The instrument has a range from 0.1 to 50 volts using an auxiliary potential of 300 volts.

Novel Power Scheme for Colorado.

A special dispatch from Denver, Colo., of September 10, has the following information of unusual interest: Nature has given this State no Niagara to harness for electricity for power and lighting purposes, so some artificial Niagaras will be built. The first is now in course of construction. As an engineering feat it has novel features. Two or three rivers are to be lifted, so to speak, from their beds, and transferred to canals, which will feed an immense reservoir. From this reservoir the water will be carried through another canal and dropped through great pipes over a precipice 1,000 feet high. The power house in which the electricity will be generated will be at the foot of the precipice. Ultimately it will have a capacity of 40,000 horse-power.

The site of this project is about 24 miles from Silverton. The Animas Canal, Reservoir, Water Power & Investment Company has been incorporated under the laws of Colorado to carry out the project. The plans and specifications were prepared by a consulting engineer in New York. The first cost of the undertaking will approximate $1,000,000, while the whole plan will involve about $3,000,000. When the project is completed it is expected to revolutionize industry in Southern Colorado. With abundant and cheap power many enterprises can be carried through which hitherto have been prevented by the cost of power obtained from steam. From the power house at the foot of the precipice electricity will be carried throughout the surrounding country.

The Animas Company has acquired water rights in a drainage area of 400 square miles in San Juan and La Plata counties. This drainage area is enclosed toward the centre, where flows the Animas River. This river between Silverton and Durango has a gradual fall of nearly 3,000 feet, most of it within twenty miles. The problem was to use a portion of this fall. At a point ten miles below Silverton the river is dammed and nearly all of its water is diverted to a canal, which is composed mostly of a box flume, six feet deep and eight feet wide. This canal follows the line of the river in a southwesterly direction about three miles and then gradually leaves it. For five more miles it proceeds, and then it is joined by another canal, three miles long, which carries the water of Lime Creek from the north. After the junction the canal is carried two miles to what is called Cascade Reservoir. This reservoir is a natural basin, three miles long and about three-quarters of a mile wide, extending north and south. In addition to being fed by the Animas River and Lime Creek it receives another supply from a canal which brings the water of Cascade Creek. This canal is about five miles long. At the southern end of the reservoir is another dam, and over this the water is poured into what is called a power canal, which proceeds southeasterly for two miles and ends in a feed reservoir. This is close by the top of a cliff 1,000 feet high. At its base flows what is left of the Animas River.

Saving this one thousand feet of gradual descent in order to have a drop of one thousand feet is expensive work, but the reward will justify the expenditure. From the feed reservoir down the face of the cliff a riveted steel pipe four feet in diameter is being extended. It will withstand the enormous pressure of nine hundred pounds to the square inch. Through this the water will drop to the power house. In the power house the first installation will consist of two large generators, each connected with a water wheel.

Note on Shawinigan Power.

The visit of the American Institute of Electrical Engineers and its foreign friends, on grand tour, to the city of Montreal and to Shawinigan renders interesting data as to the latter power enterprise. The Shawinigan Water & Power Company, of Montreal, in which New York and Boston capitalists are largely interested, owns the right to utilize the power of the Shawinigan Falls, Quebec, where the St. Maurice River plunges 140 feet to the lower river level 85 miles from Montreal. This power the company has developed hydraulically to the extent of 100,000 horse-power. Of the total power developed, 20,000 horse-power is used locally by the Northern Aluminum Company, the Canadian branch of the Pittsburg Reduction Company, the Belgo-Canadian Paper Company, the Shawinigan Carbide Company, Shawinigan Falls Electric Light Company, and other smaller concerns.

The power company has this summer been delivering 6,000 e. hp to the Montreal Light, Heat & Power Company over it 85-mile transmission line at 44,000 volts. This transmission has been described and illustrated in our pages. Demand for power in Montreal has called for the second transmission line now building and nearing completion. The two lines will allow of the delivery of 20,000 e. hp in Montreal to be supplied to the Montreal Street Railway, Montreal Heat, Light & Power and other companies. The transmission lines now aggregate over 200 miles in length and pass through fifty municipalities, all of which want to use power when the company can supply it. The generator now being installed to supply the additional electrical power for transmission is of 11,000 hp capacity, being at the present time the largest size of electrical generator in the world.

The bonded debt per horse-power actually developed is low, being only $100 per horse-power, which compares with $160 for Niagara Falls Power Company, $150 at Glens Falls, N. Y., for the Hudson River W. P. Company, $200 at Hamilton, Ont., and $133 at Easton, Pa. Hydraulic power sells at Shawinigan at less than $10 per horse-power, at Niagara Falls, at around $12 to $15. For electrical power the prices are $10 to $15 per horse-power per annum, compared with $15 to $25 at Niagara. The hydraulic development at Shawinigan is all complete for the 100,000 horse-power and the bonded debt per horse-power in the completed electrical plant will not be over $50.

Steam Railroad Third Rail.

The New York, New Haven & Hartford Railroad announces that it will lay four additional tracks between New York and New Rochelle, all equipped with electricity. The new lines will connect with the Interborough system in New York City.

Fifth International Electrical Congress

ST. LOUIS, MO.

September 12-17

Nineteen Hundred and Four

THE fifth International Electrical Congress convened at St. Louis in the Music Hall of the Coliseum, on the morning of September 12. The details with regard to the preparations for the Congress are already familiar to the readers of the ELECTRICAL WORLD AND ENGINEER. Several months ago a committee of organization was formed having as its president, Prof. Elihu Thomson; general secretary, Dr. A. E. Kennelly; treasurer, W. D. Weaver, and for vice-presidents, Bion J. Arnold, chairman executive committee, Profs. H. S. Carhart and W. E. Goldsborough, Dr. S. W. Stratton and C. F. Scott. The heavy preliminary work has been largely in the hands of Messrs. Kennelly, Weaver and Thomson, and the result of their persistent and intelligent toil is seen in the fact that the numerical strength of the Congress is far beyond anything attained by any of its predecessors. The acceptances of membership up to last week were altogether close to 2,100, and of these between 400 and 500 were from persons outside of the United States. These figures are more than double the corresponding ones for the fourth Congress in Paris, in 1900, which were more than double the membership figures of the third Congress at Chicago, in 1893. The committee on organization of the Congress was appointed by President Francis, of the St. Louis Exposition, in June, 1903, and held its first meeting in the following month. Aside from enrolling membership and thus insuring a large and representative constituency, as well as the necessary funds to meet expenses of printing the Transactions, etc., the committee had to enlist the support of leading scientists and electrical engineers all over the world in the matter of papers, the plan being to make the presentation of papers rather a matter of careful invitation than to depend upon the unsatisfactory results of haphazard and promiscuous volunteering. The number of specially invited papers up to the beginning of the Congress appears to reach over 150, of which 110 had been delivered to the authorities last week, so that nearly 100 were in type when the Congress opened this week, ready for delivery to the members in attendance. The committee of organization could have printed the others also but for the regrettable delay of the authors in preparing and sending them in. However, these papers will be put together in two or three volumes as a matter of permanent record and will constitute an invaluable review of the state of the science and art in 1904. As the subscription fee to the Congress is only $5.00 it stands to reason that the members have secured at a small outlay a fund of electrical literature of high character that it would be hard to surpass in intrinsic merit.

Aside from the chamber of official delegates to which there had been fifteen appointments at the time the Congress convened, there were eight separate sections of the Congress, as enumerated below:

Section A.—General Theory—Mathematical, Experimental. Chairman, Prof. E. L. Nichols; secretary, Prof. H. T. Barnes.

Section B.—General Applications. Chairman, Prof. C. P. Steinmetz; secretary, Prof. Samuel Sheldon.

Section C.—Electrochemistry. Chairman, Prof. H. S. Carhart; secretary, Mr. Carl Hering.

Section D.—Electric Power Transmission. Chairman, Mr. Charles F. Scott; secretary, Dr. Louis Bell.

Section E.—Electric Light and Distribution. Chairman, J. W. Lieb, Jr.; secretary, Mr. Gano S. Dunn.

Section F.—Electric Transportation. Chairman, Dr. Louis Duncan; secretary, Mr. A. H. Armstrong.

Section G.—Electric Communication. Chairman, Mr. F. W. Jones; secretary, Mr. B. Gherardi.

Section H.—Electrotherapeutics. Chairman, Dr. W. J. Morton; secretary, Mr. W. J. Jenks.

The average number of papers for reading and discussion in each section during the week is expected to be about twenty, for which four and one-half sessions are provided, representing an average schedule of four or five papers per day in each Congress section. Moreover, two topical discussions have been provided for, one for the Institution of Electrical Engineers of England in conjunction with the American Institute of Electrical Engineers, at Section A, on "Electrical and Magnetic Units," and the other for the same bodies associated with Section F on "The Best Transmission and Distribution of Electric Current for Railways."

As noted in these pages last week, in addition to the official delegates to the Upper Chamber, a number of delegates are attending the Congress from electrical and physical societies all over the world. The ELECTRICAL WORLD AND ENGINEER in its issue of September 10 presented the portraits of some twenty-sixth of these official and technical delegates, accompanied by biographical sketches of an interesting nature.

The Congress exercises opened on Monday, September 12, with a general session, Prof. Elihu Thomson making an introductory speech, and President Francis delivering a cordial and official address of welcome. He predicted that there would be fewer universal expositions in the future of the Paris and St. Louis type and more special ones. In fact an international electrical exposition was likely before many years. He said also that the electrical department at St. Louis was superior in many respects to that at previous World's Fairs. Prof. Thomson outlined the organization of the Congress and in doing so took occasion to compliment Dr. A. E. Kennelly, secretary, and Mr. W. D. Weaver, treasurer, on the excellent work they had done.

The Congress then proceeded to effect a regular organization and the following honorary vice-presidents were elected: Ascoli, Glazebrook, Gonzales, Crompton, Gray, Lombardi, Perry and Henri Poincaré, each section having one or two honorary chairmen and vice-presidents from among the foreign delegates. Due responses and acknowledgments were made by Messrs. Gray, Ascoli, De Nerville and Goldsborough. The Congress then resolved itself into its constituent sections and proceeded promptly to the reading and discussion of papers.

During the day the Chamber of Delegates also organized with Prof. Elihu Thomson as president, Dr. A. E. Kennelly, secretary, and Dr. F. A. Wolff, assistant secretary.

SECTION A.—MONDAY.

The following papers were read on Monday in Section A: Prof. H. T. Barnes, "The Mechanical Equivalent of Heat Measured by Electrical Means" (Royal Soc. Canada, paper); Prof. J. S. Townsend, "The Theory of Ionization by Collision"; Dr. A. E. Kennelly, "High Frequency Telephone Circuit Tests" and "The Alternating-Current Theory of Transmission Speed Over Submarine Telegraph Cables." Some abstracts follow:

THEORY OF IONIZATION BY COLLISION.—PROF. J. S. TOWNSEND.

The author proposes a theory to explain some of the phenomena which occur in the development of large currents in a gas. The

molecules of a gas may be ionized by the impacts of ions that have acquired their velocity under electromotive forces of 10 or 20 volts. When ultra-violet light falls on the negative electrode of parallel plates a number of negative ions are set free by the action of the light on the metal, which travels through the gas to the opposite electrode. If the gas is at a high pressure the current between the plates increases with the electromotive force and approaches a certain maximum value which is attained when all the ions generated by the light reach the positive electrode. By reducing the pressure of the gas and increasing the electromotive force, it is possible to make the ions travel with sufficient velocity to generate others by collisions with the molecules of the gas.

THE MECHANICAL EQUIVALENT OF HEAT MEASURED BY ELECTRICAL MEANS.—PROF. H. T. BARNES.

The paper discusses the most probable value of the mechanical equivalent in terms of the generally accepted values of the electric units. A difficulty encountered in determining the value of the equivalent is found in the fact that the standards for measurements are subject to error. Thus the absolute value of the e.m.f. of the standard Clark cell has as yet not been determined. By reviewing the work of others and selecting values subject to the least probable error, and comparing them with values obtained in person, the author proposes that the value 4.186 joules in terms of the mean caloric be selected, as it seems to accord with the results obtained by both the electrical and mechanical methods. This thermal unit is a mean over the range between 0 and 100 degrees centigrade (freezing and boiling points) and is thus independent of any temperature scale.

HIGH-FREQUENCY TELEPHONE CIRCUIT TESTS.—PROF. A. E. KENNELLY.

In land-line telegraphy it has for many years been the custom to test the circuits periodically by applying a steady assigned voltage to their sending ends, and measuring the strength of current received to ground at their distant ends, through a milliammeter or equivalent apparatus. The ratio between the voltage and the current strength is the receiving end impedance of the circuit at the operating frequency. If this impedance exceeds a certain value, assignable for each particular circuit, the circuit will be defective or even inoperative and will require to be overhauled. The paper describes certain apparatus constructed for the purpose of measuring the alternating current strength at telephone frequencies, received at the distant end of a telephone circuit, with a definite e.f.m. impressed on the sending end. The device selected for the purpose was the "solid barretter" used in the Fessenden system of wireless telegraphy. This consists of a minute loop of very fine platinum wire or filament. The barretter is made one arm of an inductive wheatstone bridge. A steady battery current of about 6 milliamperes is passed through the barretter. When feeble alternating currents are sent through the barretter superposed upon the steady testing current, the change in resistance of the barretter is proportional to the square of the strength of the superposed alternating current (for small values of alternating current). (See Section G, Tuesday).

THE ALTERNATING CURRENT THEORY OF TRANSMISSION SPEED OVER SUBMARINE TELEGRAPH CABLES.—PROF. A. E. KENNELLY.

The law of cables enunciated by Kelvin in 1855 has been found inapplicable to overhead land line telegraphy and telephony, and the working theory of telephony has therefore grown up independently of that of submarine cables—an unnecessary and unnatural division. If, however, the theory of alternating-current transmission can safely be extended to include the case of signalling over submarine cables, then the same theory can readily cover every case of signalling over wires. Such a theory can be made not only very comprehensive, but also very easy. The paper outlines this application of general alternating-current theory to submarine telegraphy. In dealing with power transmission circuits operated at ordinary commercial frequencies below 100 cycles per second, a simple solution is reached by placing all the capacity in a lump at the center of the circuit; and the results are sufficiently accurate for practical purposes. For higher frequencies, however, such as are presented in telegraphy and telephony over long circuits, the method of lumped capacity is usually unreliable, and hyperbolic formulæ must be resorted to if simple expressions and arithmetic are desired. Hyperbolic trigonometry is, therefore, the natural and simple key to the solution of the problem. The theory is worked out on this basis and shows that the highest speed is obtainable from a given laid cable by placing a large condenser at the sending end, impressing the assigned maximum e.m.f. on the sending end, and making the impedance of the receiving instrument (assumed of maximum sensitiveness in construction) equal to the sending end impedance, but with the opposite angle.

SPECTRA OF GASES AT HIGH TEMPERATURES.—PROF. JOHN TROWBRIDGE.

The author discusses the new conditions under which he has observed the reversal of the spectra of metallic vapor when subjected to the effects of powerful condenser discharges. The light from a capillary placed inside a Geissler tube was caused to pass through the light from a spark gap in series with the capillary circuit. When a Rowland grating was employed to observe the continuous spectrum from the capillary a reversal from the bright line from the spark gap was found to exist where the lights from the sources intersected.

In the discussion Dr. Glazebrook complimented Prof. Barnes on his work. Prof. Webster was gratified to note that the Kennelly papers showed engineers to be turning from power transmission to the equally important and difficult problems of telegraph and telephone transmission.

SECTION B.—MONDAY.

In Section B a paper which had been late in coming to hand was read from Mr. W. M. Mordey on "Eddies and Hysteresis in Iron." He said that the wattmeter was better for getting the iron loss than the galvanometer. Another belated paper was that of R. A. Jouast, of France, on "Magnetic Viscosity." It treated on time lag in magnetism with changing magnetomotive force. Prof. H. J. Ryan emphasized the necessity of observing form of current and e.m.f. curves. Prof. Ford, of Columbia, denied viscosity. Dr. C. H. Sharp held that low iron loss required low hysteresis factor and high resistance. C. A. Adams remarked that results could be explained without assuming viscosity. Mr. Duddell said that the oscillograph gives the hysteresis loop directly. The following papers were also read: Dr. Clayton H. Sharp, on "The Equipment of a Commercial Testing Laboratory"; M. A. Nodon, on "Rectifiers," and B. A. Behrend, on "The Testing of Alternating-Current Generators." Abstracts follow:

THE EQUIPMENT OF A COMMERCIAL TESTING LABORATORY.—DR. CLAYTON H. SHARP.

In a commercial testing laboratory it is essential that the work be carried out with accuracy, celerity and economy. The paper describes the preferred methods for distributing the circuits for the delivery of electric current and the sources of current which should be available. The standards of e.m.f., resistance, candle power, and the instruments for measuring current power, illumination, etc., are discussed. Both Weston and Clark cells have proved reliable as primary standards of e.m.f., while Weston voltmeters are thoroughly good as secondary standards for both direct and alternating e.m.fs. For measuring current a Kelvin balance is the best instrument, though for direct current a standard manganin low-value resistance with Weston millivoltmeter is accurate within 0.1 per cent. The Duddell-Mather type of wattmeter fulfills all requirements for power measurements. As primary standards of luminous intensity the Hefner lamp and the Harcourt 10-candle power lamp are best. Carefully seasoned incandescent lamps furnish excellent secondary standards of light. For high-tension tests, an oil-insulated transformer of considerable capacity is required. For the measurement of high potentials, Kelvin electrostatic voltmeters can be used with good results. A highly insulated spark gap furnishes means of determining the maximum voltage. Oscillographs serve admirably for studying instantaneous phenomena with rapidly varying currents. For alternating current curves, instantaneous contact makers are used, being driven by synchronous motors. For photometric tests with incandescent and arc lamps, the photometers of Professor Matthews are excellent.

THE TESTING OF ALTERNATING-CURRENT GENERATORS.—B. A. BEHREND.

The paper describes an improved method for testing alternating-current generators and synchronous motors under full-load conditions, without actually having to place the machines under full load. Instead of having to divide the armature into two sections, as suggested first by Mordey, Behrend splits the fields into two sections and connects these sections in such a manner that the e.m.fs. induced in the armature are in opposition. Test curves given in the paper show that the method produces results closely equivalent to loading the machines.

The Behrend paper was discussed by Messrs. Ryan, Waters, Rushmore, Adams and Steinmetz, some of them criticising the method.

SECTION C.—MONDAY.

In this section, a paper was read by Prof. T. W. Richards, on "The Relation of the Hypothesis of Compressible Atoms to Electrochemistry." It was followed by a brief discussion by Carhart and Patterson. Abstract follows.

THE RELATION OF THE HYPOTHESIS OF COMPRESSIBLE ATOMS TO ELECTROCHEMISTRY.—PROF. THEODORE W. RICHARDS.

Having observed that the volume of a solid chloride or bromide was much less than the sum of the volumes of the metal and the liquid chlorine or bromine entering into its composition, and that the change in volume was the greater the more energetic the reaction, the author was led to conclude that the compressible environment is an essential part of the atom, or, in other words, that the atom itself is compressible. This hypothesis is entirely consistent with the corpuscular conception of atomic structure. For each union with other atoms, a given atom would give and suffer a shock of impact or combination. If the atom is compressible throughout, many forms of vibration or temporary rhythmical distortion might be possible because of this shock. One of the most probable forms is a vortex motion, and if the atom were perfectly elastic, such a vortex would continue to exist indefinitely when once formed. The hypothesis allows of an easy explanation of Faraday's law of the quantity of electricity transferred, by imagining that each collision of atomic combination starts or transfers a vortex or some other form of self-perfecting shock.

SECTION D.—MONDAY.

In Section D, Sig. E. Bignami's paper on "Electrical Transmission Plants in Switzerland" was read. Chairman C. F. Scott presented an historical sketch of American electrical power transmission. Dr. F. A. C. Perrine contributed to the general discussion and comparison as to respective American and foreign practice. This was quite interesting and was participated in also by Messrs. Hutton, Bell, Waters and Kilburn Scott.

SECTION E.—MONDAY.

The following papers were presented on Monday in Section E: Arthur Wright, on "Recent Improvements in Electrolytic Meters"; E. de Fodor, on "Rates for Electricity Supply"; G. Eastman, on "Protection and Control of Large High-Tension Alternating-Current Distribution Systems" (N. E. L. A. paper); W. C. L. Eglin, on "Rotary Converters and Motor Generators in Connection With the Transformation of High-Tension Alternating to Low-Tension Street Current" (Assn. Edn. Ill. Co.'s paper). Two abstracts follow:

RATES FOR ELECTRICAL SUPPLY.—ETIENNE DE FODOR.

The author reviews in detail the causes which have led to the prices placed upon electric current used for lighting and power purposes, competition with gas having been in most cases the controlling factor. In order to effect a proper introduction of the electric motor and make its advantages known, it was necessary for central stations to offer certain inducements in the form of cheap or reduced rates for power current. From a table giving the prices charged for electrical energy in fifty cities, it is shown that the normal unit price for power current is about one-third of that charged for light. Since no restrictions have been placed as to the time when such power should be used, the electric companies have failed to recognize the logical situation. Power users see no reason why they should not demand the same rates for light as they have for power, since the light they use is also for "industrial" purposes. The author proposes to establish a unit rate for light and power, the unit rate to be divided into two classes or steps, according to the time at which the energy is consumed. Unfavorable peak loads due to the simultaneous operation of motors and lamps in the evening can be obviated by such a double-tariff system when there is a great difference between the maximum and cheaper rate.

PROTECTION AND CONTROL OF LARGE HIGH-TENSION ALTERNATING-CURRENT DISTRIBUTION SYSTEMS.—GEORGE M. EASTMAN.

The principal object to be attained in the installation of protective apparatus is continuity of service. The various elements which enter into the determination of the protection needed are treated individually. In an alternating-current system the condensance performs the function of elastic ligaments, connecting the system to ground. The effect of a ground on a system depends upon the nature of the ground and the value of its reactance in relation to the condenser reactance. It is shown that a ground connection on an underground system would cause considerable more trouble than on an equivalent overhead system. In order to eliminate the chances of obtaining excessive electrostatic disturbance on the system, the proper means to employ is the permanent grounding of the neutral of high-potential systems. Ground detectors, overload relays and oil circuit-breakers are discussed, and the importance of periodic inspection and tests of all protective apparatus is emphasized.

The Fodor unit rate was discussed by Messrs. Doty, L. A. Ferguson, A. Williams, Col. R. E. Crompton and Dick.

SECTION F.—MONDAY.

In Section F on Monday the following papers were read: Philip Dawson, on the "Electrification of British Railways," and J. B. Entz, on "The Storage Battery in Electric Railway Service." In the discussion of the Entz paper, Messrs. F. J. Sprague, Bion J. Arnold and H. Ward Leonard favored strongly the development of heavy traction. The papers were not readily available for abstracting.

SECTION G.—MONDAY.

In Section G on Monday papers were presented by Saitaro Oi, on "Telegraphy and Telephony in Japan," and Joseph Hollos, on "Simultaneous Telegraphy and Telephony," one of which is abstracted below.

TELEGRAPHY AND TELEPHONY IN JAPAN.—SAITARO OI.

The first telegraph line in Japan was constructed between Tokyo and Yokohama in 1869. In 1903 there were 4,216 telegraph instruments in use, requiring 80,213 miles of wire. The telegraph was first brought to Japan in 1877 by a mechanic returning home from America. In 1903 there were 36,700 sub-stations using 40,593 miles of wire. The automatic telephone, which has come into use since 1899, is so constructed that the operator is enabled to distinguish the kinds of coins put into the slot by having different sounds made by the coin in its sliding down along a chute. No party lines are in existence at present. The actual number of toll line circuits amounts to about 100. In a small provincial town which is connected by a toll line to any other town having an exchange, people can be connected at their own expense to the post-office of the specified town. Small switchboards are provided and worked in such post-offices by the Government. Seventeen such special exchanges are now working.

SECTION A.—TUESDAY.

At the meeting of Section A on Tuesday, papers were presented by Prof. Dr. Moise Ascoli, on "Systems of Electric Units" (A. E. Ital. paper). Prof. H. S. Carhart and Prof. G. W. Patterson, Jr., on "The Absolute Value of the Electromotive Force of the Clark and Weston Cells," and Dr. F. A. Wolff on "The So-called International Electric Units," the last-named being abstracted below:

THE SO-CALLED INTERNATIONAL ELECTRICAL UNITS.—DR. FRANK A. WOLFF, JR.

The paper gives an historical sketch of the efforts which have been made to bring about uniformity in the electrical units. The various specifications for columns of mercury as standard of resistance, the numerous definitions which have been given for the ampere as determined with the silver voltameter and the changes which have been found necessary in the constants of e.m.f. for standard cells, are treated in great detail. Revised specifications for a standard cell of either the Clark or the Weston type are offered. The e.m.f. of the Clark cell is stated to be 1.433 and considered accurate to at least one part in 2,000.

In the discussion which followed on units, the British opposed the Heaviside rationalization, while the foreigners inclined toward the silver voltameter and the Americans supported the standard cell.

SECTIONS B AND F.—TUESDAY.

The two sections B and F held a joint meeting on Tuesday for the discussion of alternating current motors, the subject matter affording so much food for discussion in common. Among the papers presented were the following, which made quite a field day: Dr. O.

S. Bragstad, "Theory and Method of Operation of Repulsion Motors"; P. M. Lincoln, "Transmission and Distribution Problems Peculiar to the Single-Phase Railway System"; Dr. C. P. Steinmetz, "Theory of the Single-Phase Motor" (A. I. E. E. paper); Max Deri, "Single-Phase Motors"; Ernst Danielson, "Theory of the Compensated Repulsion Motor"; B. J. Arnold, "Some Early Work in Polyphase and Single Phase Electric Traction"; Dr. F. Niethammer, "Alternating vs. Direct Current Traction." A paper was also presented by Mr. Latour. Abstracts of some of these follow:

ALTERNATING-CURRENT MOTORS.—C. P. STEINMETZ.

The paper gives a mathematical discussion of all standard types of alternating-current motors—synchronous, induction and commutator motors. Under induction motors, the polyphase, single-phase and single-phase condenser motors are treated, while of the commutator motors, the polyphase shunt, polyphase series, plain single-phase series, inductively and directly compensated series (Eickemeyer, Steinmetz, Lamme) repulsion and compensated repulsion (Latour, Winter-Eichberg) motors are discussed at great length. The author treats the general alternating-current commutator motor as a machine consisting of two field coils in quadrature and two sets of brush circuits, also in quadrature, and derives general equations for expressing the electromotive force in each circuit. The various types of motors differ according to in which circuits the impressed e.m.f. is zero (short circuited) and in which circuits the current is the same (series connected). The treatment is essentially more complete than any previously given since the short circuit of the brush is taken into consideration. It is shown that of the various machines the repulsion motor possesses the highest starting torque and the most rapid decrease in torque and power with increase of speed, and reaches zero torque and power at a definite speed. The single-phase series motor shows the lowest torque in starting, the highest at high speed; that is, its torque decreases least with increase of speed, so that in the case illustrated it almost approaches a constant torque motor. The compensated motor is intermediate between the repulsion and the series motor, but rather nearer to the former at low and to the latter at high speeds; that is, its torque is high at starting and at low speeds, but does not fall off as rapidly at high speeds as that of the repulsion motor. The repulsion is a low-speed motor, the series a high-speed motor, while the compensated motor is intermediate between the repulsion and series motors.

THEORY AND OPERATION OF THE REPULSION MOTOR.—O. S. BRAGSTAD.

A general theory of the repulsion motor is developed under the assumptions that the magnetic reluctance is constant for all magnetic circuits and that the ion losses are proportional to the square of the induction, the short-circuiting of the brushes being neglected. The mathematical equations are first obtained, then graphical diagrams are given for representing the equations under the assumption of constant primary current. A diagram is then developed for representing the performance with constant terminal pressure. It is shown that the diagram is applicable for determining the performance when tests are made with the rotor stationary for finding the short circuit and open circuit impedance and the starting torque.

TRANSMISSION AND DISTRIBUTION PROBLEMS PECULIAR TO THE SINGLE-PHASE RAILWAY.—PAUL M. LINCOLN.

An apparent handicap for the single-phase in comparison with the three-phase transmission system is the fact that the copper required is in the ratio of 4 to 3. This ratio holds true on the basis of equal potential between wires, but if equal normal potential to ground be considered the basis then the single-phase and the three-phase are on an equality. A polyphase generator is cheaper by 30 per cent. than a single-phase machine of the same capacity, hence it is advantageous to use polyphase generators for supply, dividing the load as equally among the phases as possible. A disadvantage is found in thus operating from a polyphase circuit, since if one of the three wires be taken away, the sum of the static potentials no longer remains at zero, and static induction will take place on neighboring (telephone) circuits without the possibility of correction by any method of transposition. After discussing the application of Kelvin's law for the determination of maximum commercial economy of conducting material and the relation of the voltage drop to the spacing of transformer stations, the author concludes that there is no golden rule for the determination of the spacing and capacity of transformer stations or of the size of the conductor. It is a matter of compromise between various elements, some of which point in one direction and some in the other, and is a matter which must be determined by engineering judgment rather than by any inflexible law.

SINGLE-PHASE MOTORS.—MAX DERI.

The author discusses with the aid of surface and performance diagrams the various types of single-phase motors, the induced compensated series motor, and the repulsion with several modifications. The compensated single-phase with damping coil to neutralize field reactance formed by short circuit through brushes on the commutator (Latour) represents on the whole a more completely developed repulsion motor. It possesses the disadvantage of requiring a double brush system, a special transformer is necessary, as a rule, for excitation, and it is often necessary to apply also special arrangements for regulation. The author describes his arrangement, which employs series connected field and armature coils as in the plain series motor. Certain points on the commutator are short-circuited together, thus forming a closed circuited armature. The machine constitutes to a certain extent an externally excited and, consequently, externally controlled induction motor. The author claims the following advantages for this motor: Brushes carrying main working currents are not used; therefore all commutator difficulties at starting and low speeds disappear entirely. The commutator can be made quite narrow and a small number of brushes may be used. In principle, this motor is an induction motor which transmits external energy by means of transformation to a simple rotor. The motor can be started with greatest starting torque, its output can be made considerable, and its power factor made nearly unity. By this combination there is obtained an externally excited, compensated induction motor.

THEORY OF THE COMPENSATED REPULSION MOTOR.—ERNST DANIELSON.

The compensated repulsion motor is one in which in series with the primary circuit there is connected a circuit through the armature approximately 90 degrees from the axis of the normal short circuit of the secondary. The treatment of the author is exclusively mathematical and cannot well be abstracted.

The discussion on these was participated in by Messrs. Lamme, Steinmetz, Waters, Scott, Lincoln, Armstrong and others, on application rather than design, and the desirability of three-phase transmission with single-phase operation. Armstrong and Lamme advocated the adoption of a standard alternating trolley voltage, in view of the adoption of that type of current for work at the car and on the contact devices.

SECTION C.—TUESDAY.

In Section C on Tuesday the following papers were presented: J. S. Edstrom, "Electrical Extraction of Nitrogen from the Air"; Prof. W. D. Bancroft, "The Chemistry of Electroplating" (Am. Electro Chem. Soc. paper); Messrs. A. G. Betts and E. F. Kern, "The Lead Voltameter"; Prof. L. Kahlenberg, "The Electro Chemical Series of the Metals" (Am. Electro Chem. Soc. paper); Mr. J. Swinburne, "Electrolytic Smelting of Sulphide Ores." Dr. Haber, "The Carbon Cell". There was a general discussion on all these. Brief abstracts are given below:

THE CARBON CELL.—PROF. DR. HABER AND DR. L. BRUNER.

The cell consists of the following: carbon-fused sodium hydrate-iron. The behavior of each of the electrodes is considered separately, and it is shown that the true nature of this cell is different from what it was supposed to be. Thermoelectric phenomena take no part in the production of the electromotive action, for these forces do not depend on the materials iron and carbon, but only on the gases oxygen and hydrogen. From the theoretical standpoint the hydrogen-oxygen chain offers very much of importance. It is differenentiated from the old well-known Grove hydrogen-oxygen chain, in that it is not liquid water, but a solution of water in fused sodium hydrate, which is produced by its action. One can carry out the theoretical conception on the basis of the Helmholtz relation between the electromotive force of reversible galvanic chains and the reaction heat of the process. One can suppose at the start that an equilibrium exists between a fused salt containing water and the vapor pressure of the water above it, and can calculate the vapor pressure above the fused sodium hydrate at different temperatures. The result of such calculations is that the vapor pressure at 300° is extremely small and increases with increasing temperature. The fused mass is therefore especially hygroscopic near its point of solidification, and the force of the hydrogen-oxygen chain at this temperature is the highest. That the force of the carbon cell in-

creases with the temperature is not in contradiction with this, but is explained by the fact that the evolution of hydrogen by the carbon increases in rabidity very quickly with increasing temperature.

THE ELECTROCHEMICAL SERIES OF THE METALS.—PROF. LOUIS KAHLENBERG.

The prevalent conception of the electrochemical series of the metals is the arrangement of the latter in a series so that any metal will be electropositive to all that follow it and electronegative to all that precede it. The result of work carried on during the past six years shows the fact that at a fixed temperature the difference of potential between a metal and an electrolyte depends upon the character of the metal and upon the composition of the electrolyte and that every ingredient used in making up the solution affects this difference of potential to some extent, and frequently very materially indeed. A clear recognition of these changes in the elecchemical series is of great importance in electrochemical practice, particularly in the electrolytic separation of the metals.

THE CHEMISTRY OF ELECTROPLATING.—PROF. WILDER D. BANCROFT.

Due to the neglect of chemistry involved there has as yet not been produced any consistent theory of electroplating. After giving a discussion of facts connected with the phenomenon of electroplating, the author sums the results as follows: A bad deposit is always due to precipitation with metal of some salt or non-metal. Addition to the solution of anything that will dissolve this salt or non-metal will tend to prevent its precipitation and to improve the quality of the deposit. Any beneficial action of a reducing agent is probably due to the removal from the solution of dissolved oxygen. A fine-grained deposit is favored by high-current density and potential difference, by acidity and alkalinity, by low temperature and by colloids. Solutions containing oxidizing agents appear to yield small crystals, while larger crystals are obtained from solutions containing reducing agents. The adherence of deposits rests on the adhesion of the two metals.

THE LEAD VOLTAMETER.—A. G. BETTS AND E. I. KERN.

On account of the higher cost of silver as a depositing metal and the fact that the silver is greatly inclined to separate as crystals which are loosely attached to the cathode, thus allowing some of the deposited silver to become detached when heavy currents are sent through the apparatus for considerable length of time, attempts have been made to substitute other metals for silver in voltameter work. Copper has been used, but it possesses the disadvantage of low electro-equivalent weight and has two valencies, so that a given current under certain conditions may deposit twice as much metal as under others. The paper shows that lead whose equivalent weight is approximately equal to that of silver and which has one valency is in many cases a proper substitute for silver in voltameter work. The electrolytic deposit is perfectly smooth, dense and non-crystalline.

CHLORINE IN METALLURGY.—JAMES SWINBURNE.

The paper deals with a new process in metallurgy depending on the action of chlorine. Chlorine has been used in metallurgy before for attacking metallic gold; and salt has been employed for "chloridising" roasting. The present process is, however, a new departure of quite a different kind, and is really a new form of metallurgy calculated to displace the oxidation and reduction processes now in use. The principle of the process is treating sulphide ores, without previous roasting, with chlorine, so as to form chlorides of the metals, the sulphur being liberated as such. The chlorides are then electrolysed, yielding metals and recovering the chlorine. The chlorine thus goes round and round; and the process in its simplest form is analogous to separating the sulphur from the metals electrically, and changing the ore at the mere expense of electrical energy into its component metals and sulphur.

SECTION D.—TUESDAY.

In Section D on Tuesday, Mr. J. S. Peck's paper on "The High-Tension Transformation in Long-Distance Power Transmission" was mainly a review of the transformer practice of the past ten years. The following papers were also presented: Prof. H. B. Smith, "Notes on Experiments with Transformers for Very High Potentials"; Dr. F. A. C. Perrine, "American Practice in High-Tension Line Construction"; Prof. F. G. Baum, "High Potential Long-Distance Transmission and Control." The transformer oil risk and the Baum paper were discussed. Abstracts are given below:

AMERICAN PRACTICE IN HIGH-TENSION LINE CONSTRUCTION.—DR. F. A. C. PERRINE.

In the choice of voltage it is considered best practice to use 1,000 volts per mile, provided the length of transmission be not above 60 miles, since above 60,000 volts no commercial work has been regularly operated. Where direct generation at 6,600 or 12,000 volts has not been resorted to, the practice is tending to the use of 2,300 volts. The 2,300-volt oil switch is both better and cheaper than any 500-volt switch on the market. For plants operated at less than 25,000 volts, the step-up transformers are either the water-cooled, oil-filled or the air-blast type. Oil switches with either horizontal or vertical break are the standard to-day, no preference being given to the horizontal switch, though the author believes that in the future this type will be used as a standard for the highest potentials. For transmission at less than 25,000 volts, the delta connection of transformers is preferable; above this value star connection should be used. As regards conduction materials, the only ones at present available are copper and aluminum, preference between them being almost entirely a matter of price of transmission lines. For voltages above 25,000 no thoroughly satisfactory lightning arrester has been presented.

HIGH POTENTIAL, LONG-DISTANCE TRANSMISSION AND CONTROL.—F. G. BAUM.

After giving the equations for determining the charging current for three-phase lines and the inductance pressure due to any chosen current, the author discusses the rise in pressure due to the charging current, assuming for this purpose that the actual condensance of the line is concentrated at the centre and that the leading current which it consumes is drawn through one-half of the total line inductance. In investigating the surges produced by opening a line under load or short circuit, a similar assumption is made as to the distribution of the reactances. It is shown that, due to the series connection of the line inductance and condensance, the energy stored in the magnetic field of the conductors under condition of excess current, when the terminal circuit is opened, must pass into the line condensance and later be discharged into the inductance, the surges thus produced assuming a frequency corresponding to the square root of the product of the self-induction and capacity of the line, as is well known. The rise in potential due to the surging current is as a first approximation independent of the length of the line and equal to 200 times the interrupted current in amperes.

The author describes in detail the insulator selected for the greatest transmission system in existence, that of the California Gas & Electric Corporation, which operates 700 miles of 50,000-volt transmission circuits. In the construction of the pole line, iron pins are used on all new work, and towers are considered the ideal supporters for the wires, though but few are used at present. Advantage has been taken of hills and ravines to use long spans, 1,000 to 1,800 feet, of aluminum wires. The general practice is to generate at 2,300 volts and step up to the line voltage, the primary of the transformer being connected star with grounded neutral.

NOTES ON EXPERIMENTS WITH TRANSFORMERS FOR VERY HIGH POTENTIALS.—PROF. H. B. SMITH.

After an historical sketch of the work of development done at Purdue University and Worcester Polytechnic Institute in the construction of high potential transformers, the author gives the details of design of a transformer built under his direction which develops a secondary potential of 500,000 effective volts. This transformer has been used for three years. Tests made with the transformer indicate that with slight modification of the secondary winding a potential of not less than 750,000 volts effective, or over a million volts maximum, can be secured from it. Over a thousand gallons of oil are required for insulating the secondary winding, which contains about 125 miles of 32 B. & S. wire. The writer recently built a 300,000 volt transformer, of 200-kw capacity, which is now in commercial use by the Locke Insulator Manufacturing Company, Victor, N. Y., for testing high voltage transmission insulators. Design data of this transformer are given in the paper.

SECTION E.—TUESDAY.

In Section E on Tuesday the following papers were read: Carl Roderbourg, "The Prussian System of Electric Train Lighting"; E. Jona, "Insulating Materials in High-Tension Cables" (A. E. Ital. paper); P. Torchio, "Distributing Systems From the Standpoint of Theory and Practice"; "Alex. Dow, "The Continuous Current Sys-

tem of American Cities"; Dr. G. Stern, "The Superiority of the Alternating Current for Distribution in Large Cities"; L. A. Ferguson, "Underground Electrical Construction" (Ass'n Ed. Ill. Co.'s paper). Col. R. E. Crompton also presented a paper on the "Standardization of Dynamo Electric Machinery and Apparatus." Abstracts of some of these are given below:

THE SUPERIORITY OF ALTERNATING CURRENT FOR THE SUPPLY OF CURRENT TO LARGE CITIES.—DR. GOTTHOLD STERN.

The author treats at length of the relative advantages of direct and alternating-current systems and shows that alternating current can be delivered to customers much more cheaply than can direct current, while for most purposes the former is better adapted for the requirement of the customers. On account of the recent tendency to adopt single-phase distribution due to the successful development of successful single-phase motors, the author suggests that the ideal dynamo should be somewhat similar to the monocyclic machine, with a heavy single-phase winding and a lighter auxiliary winding in quadrature proportioned in number of turns so as to give three-phase alternating current for operation of polyphase motors. The machine would generate 3,000 volts at 50 cycles per second.

THE PRUSSIAN SYSTEM OF ELECTRIC TRAIN LIGHTING.—HERR CARL RODERBOURG.

A most interesting system for obtaining constancy of illumination notwithstanding variation of supply e.m.f., and regulation for variation in speed of the generator without special devices, is described by the author. The principle of the constant e.m.f. at the lamps with a variable e.m.f. of the source of energy is attained by the insertion of very small iron wire in the circuit of each incandescent lamp. When such a wire is connected in series with the lamp, the e.m.f. at the supply terminals can be considerably increased without subjecting the lamp to an excessive current. If the current tends to increase, the temperature of the wire increases and its resistance is considerably increased, so that within wide limits of e.m.f. the current is kept fairly constant. With a certain adjustment of resistance and lamps, a variation of e.m.f. from 56 to 86 volts changed the current taken by the lamp from 8.0 to 8.7 amperes. No such extreme change of e.m.f. takes place at the storage batteries used in the train lighting, and the variation in the illumination of the cars is not perceptible to the eye under operating conditions.

A turbo-dynamo generating unit, consisting of a short dynamo driven at 2,000 r.p.m. through a 10 to 1 reduction gear by means of a 20-hp De Laval steam turbine mounted on the boiler of the locomotive, has given excellent satisfaction in connection with storage batteries which act mainly as a reserve. In many instances it is found desirable to drive the generator from the car axle and not from a separate steam prime mover. In order to overcome the difficulties found with automatic low-current circuit-breakers used for interrupting the current if the speed of the dynamos falls below a certain limit, there has been substituted therefore an electrolytic rectifying cell.

The electrodes of the electrifying cell consist on one side of aluminum and on the other of iron which is not soluble in the electrolyte of the cell. This cell acts as a check valve in the train-lighting system, on account of the property of aluminum which causes the insulating film formed on its surface to interrupt a current even at several hundred volts if sent through the aluminum into the electrolyte in a positive direction, but allows the current to pass almost without diminution if the direction is reversed.

In order to provide for the generation of electricity in event of the dynamos being driven in the opposite direction, there is used an arrangement by means of which the commutator brushes are carried forward until a point is reached at which the dynamo generates e.m.f. in the same direction as before. By the use of four aluminum cells in the conversion of alternating into direct current, this mechanical arrangement can be avoided.

An arrangement is in preparation for prevention of the excessive charging of the storage battery at very high speeds. The dynamo, which in general is designed as a shunt machine, is to be provided with a series coil differentially connected, so that an increase in current weakens the field and lowers the generated e.m.f.

THE DIRECT-CURRENT DISTRIBUTING SYSTEMS OF AMERICAN CITIES.—ALEX. DOW.

The paper describes the Edison direct-current system of distribution and states the reason for the adoption and retention of that system, and in a sense is intended to be a justification of the methods used. The statements made are all familiar to American electrical engineers. It is on account of the international character of the Congress that they are assumed not to be matters of general knowledge by visitors from abroad.

STANDARDIZATION OF DYNAMO ELECTRIC MACHINERY AND APPARATUS.—COL. R. E. CROMPTON.

In England a committee was appointed by the Council of the Civil Engineers about three years ago at the suggestion of Sir John Wolfe Barry originally to standardize rolled iron and steel sections, but this led to the formation of other committees to deal with the standardization of all classes of machinery and parts used by engineers wherever such standardization seemed to be necessary or advantageous to manufacturers or users. Sub-committees appointed to deal with electrical questions have now been at work for two years. That which dealt with cables has issued a very complete report and recommendation. That dealing with tramway material has reported on part of the material they use. The third, dealing with dynamo-electric machinery, has recently issued an interim report which is printed an an appendix to the present paper. This is laid before the Congress in the hope that any discussion which follows on the paper may be of service to all engaged in the work. Col. Crompton is the delegate of the British Institution of Electrical Engineers.

UNDERGROUND ELECTRICAL CONSTRUCTION.—LOUIS A. FERGUSON.

Electric companies in the United States are practically committed to the drawing-in system of cables and conduit, and it is to such a system that this paper refers particularly. What is commonly known as the Edison "tube system" has been in the past used extensively for low-tension work, and it is still used to a limited extent, but on account of the relatively short life of the tube and the higher cost of repairs, its use in late years has greatly diminished. The principal advancement during the past ten years has been in the more general use of paper insulated cable as compared with rubber, the manufacture and installation of cables for extremely high voltages, the doing away with wood pump log and other inflammable material for conduit work, and a more stable character of construction in general. The next ten years will probably see underground cables worked at much higher voltages than those now used, possibly different material used for insulation purposes, and better methods of protecting underground cables.

DISTRIBUTING SYSTEMS FROM THE STANDPOINT OF THEORY AND PRACTICE.—PHILIP TORCHIO.

The factor which determines the selection of distributing systems as discussed by the writer are: (1) The amount and character of business; (2) the local field of development; (3) the density of distribution; (4) the local conditions of cost of real estate for installations; (5) the fire hazards; (6) patents and questions of policy; (7) the cost of capital and (8) the cost of station supplies. The author considers eighteen possible solutions of the problem and determines the cost and efficiency of each system required. By successive eliminations the problem is brought down to a selection between four systems of which one (designated as No. 2) has marked advantages over the other three, where local conditions warrant the distribution from the generating station to transformers in manholes or customers' premises. No. 2 involves single-phase distribution for lights and 500 volts direct current for power, two-phase supply circuit being assumed, each phase feeding a separate district, and each group of the same phase of secondary district mains connected in two solid mesh secondary networks.

In the discussion of train lighting, the use of accumulators on the cars was advocated, but without dynamos. In the discussion of the Torchio paper, Messrs. Crompton and Hammond favored high voltage incandescent lamps and direct-current distribution. Mr. Hammond opposed strongly the combination of alternating and direct distribution, and said that alternating-current elevators were impossible for over 250 feet. Mr. Arthur Williams claimed from practical observation on both sides of the Atlantic that lighting standards were higher in this country than abroad.

SECTION G.—TUESDAY.

In Section G on Tuesday the following papers were taken up: John Hesketh, "A New Danger to Lead-Covered Aerial Telephone Cables", J. C. Barclay, "Modern High-Speed Printing Telegraph

Systems"; P. B. Delany, "Rapid Telegraphy"; F. J. Dommerque, "The Telephone Problem in Large Cities"; Dr. A. E. Kennelly, "High Frequency Telephone Circuit Tests"; Prof. F. Lori, "Rapid Telegraphy"; K. B. Miller, "Automatic vs. Manual Telephone Exchanges"; L. M. Potts, "Printing Telegraphy"; Col. S. Reber, "The Military Use of the Telegraph, Telephone and Cable." The Kennelly paper was highly praised for its intrinsic value. Abstracts of some of the papers follow:

LOADED TELEPHONE LINES IN PRACTICE.—DR. H. V. HAYES.

It has been shown mathematically that if several loading coils lay within a wave length on any particular loaded circuit, and the coils themselves were theoretically perfect, the circuit was distortionless. The spacing of the coils depends upon the highest periodicity that should be retained in the telephone waves in order to maintain the character of the voice waves unimpaired. The paper gives curves showing the results of actual tests made on commercial loaded circuits using standard terminal apparatus at the transmitting and receiving stations. In the case of cables there is a distinct improvement in the quality of the transmission produced by the introduction of the loading coils, the voice of the speaker being received more distinctly. The marked diminution in attenuation, the improvement in quality of transmission, and the ease with which inductance coils can be placed on cable circuits without introducing other injurious factors, such as leakage or cross-talk with other circuits, render the use of loaded cable circuits especially attractive. The reduction of attenuation on air-line circuits, even under theoretically perfect conditions, is less than can be obtained on cable circuits, due to the fact that on the latter the capacity is large and the inductance is small, while on the former the inductance is much greater and the capacity quite small. The addition, therefore, of loading coils to aerial circuits cannot be expected to effect any improvement in the quality of transmission, whereas in the case of cables the additional inductance renders the circuit practically distortionless and effects a marked improvement in the clearness of the transmitted speech.

THE TELEGRAPH, TELEPHONE AND CABLE IN WAR.—MAJOR SAMUEL REBER, U. S. A.

The use of electrical means of communication is now absolutely necessary to success in war, not only in the grand strategical combinations of a campaign, but also in the varying technical situation on the field of battle. The development of the use of the means of communication in war has been along lines similar to those of commercial practice. The engineering principles are the same, but the operative conditions are more exacting and difficult. The essential requirement is absolute certainty of service, independent of dictates of economy. The service of communication is separated into field and fortress work. The fortress system consists of the permanent lines, usually underground, the details of which are zealously preserved as Government secrets. For armies operating in the field a complete chain of communication should exist from the outposts to the main base of operation. By the use of light field cable and bare wire a detached cavalry column can be connected during its movement with the main body. The paper contains an historical sketch of the use of electrical means from 1839 down to the present time. The part played by the cable in the history of recent years has completely proved that its rôle is scarcely inferior to those of the military and naval forces themselves. In the war of the future between two naval powers, the result will depend largely upon coal and cables.

MODERN SPEED PRINTING TELEGRAPH SYSTEMS.—J. C. BARCLAY.

Until quite recent years the usefulness of the printing telegraph systems which have been devised and put into operation has been restricted to stock and market reporting or other enterprises of a more or less private character. It may be remarked that no matter what kind of transmitting current may be employed, a satisfactory system at the present time calls for page printing at a high rate of speed, over considerable distance; and some few of the latest inventions take note of these essential requirements. To Mr. C. L. Buckingham belongs the credit of having invented the first really rapid, long-distance, page-printing mechanism that was ever successfully employed for the transaction of ordinary telegraph business. The author describes the Buckingham system in detail and points out its defects. Much remains to be done in the way of simplifying and more nearly perfecting the working apparatus.

RAPID TELEGRAPHY.—P. B. DELANY.

The limitations to speed with telegraph instruments now in use are mentioned by the author, and the need for more rapid service is treated at some length. The objections to various systems are recited and requirements for a successful system are outlined. The telegraph of the future must be a comparatively rough-shod affair, oblivious to foreign influences and capable of high-rate actuations. In the chemical system alone can these conditions be obtained. According to recent improvements the perforated message is made up entirely of dots, no dashes being perforated or transmitted. All impulses have the same time value, and each succeeding one is of opposite polarity to the one before it. The time elapsing between a positive making impulse and the negative spacing impulse determines whether the character is a dot or a dash. An improvement of importance consists of a perforator worked by a keyboard transmitter, so that any typewriter can perforate without even knowing the Morse code.

A NEW DANGER TO LEAD-COVERED AERIAL CABLES.—JOHN HESKETH.

The paper is a report of observations made in Australia concerning holes found in cable sheathing. The trouble was found to be due to an insect, the beetle Ecelonerus. A remedy for the trouble has not yet been found. It will be recalled that similar trouble was reported from Shanghai (Elec. World and Eng., July 16, 1904) caused by wasps. The damage to the cables in the former case seems not to bear any marked resemblance to that in the latter. The beetle appears actually to eat the metal.

SECTION C.—TUESDAY NIGHT.

On Tuesday evening, in Section C, Dr. Hans Goldschmidt lectured with illustrations on the subject of "Thermit" and the application of thermit welding methods in the arts.

The attendance at the Congress reached about 600, and in this respect is probably ahead of previous affairs of the kind. Very great interest has been shown in the proceedings. At this stage of the work it seems probable that the delegates will recommend a five years' International Commission, which shall dispose of the work hitherto falling upon the official delegates sent by their respective governments. During the week the Congress authorities had the pleasure of learning that France had cabled appointing five delegates, including Poincaré and Prof. Janet, and that England had appointed three, namely, Dr. Glazebrook, Prof. Perry and Col. Crompton. This apparently left only Germany officially unrepresented among the great nations.

WEDNESDAY SESSION.

On Wednesday the Congress work was varied by a joint meeting of the British Institution of Electrical Engineers and the American Institute of Electrical Engineers at the World's Fair in order to discuss the application of alternating current to the purposes of railway traction.

SECTION A.—THURSDAY.

On Thursday, in Section A, the following papers were taken up and discussed: Dr. E. B. Rosa and Mr. F. W. Grover, on "The Absolute Measurement of Induction"; Dr. K. E. Guthe, on "Coherer Action"; Prof. C. D. Child, "The Electric Arc"; Prof. J. C. McLennan, "Radio Activity of Mineral Oils and Natural Gases"; Prof. E. Percival Lewis, on "The Electric Conductivity of Gases"; Dr. H. Pender, on "The Magnetic Effect of Moving Charges"; Dr. M. I. Pupin, on "Electrical Impulses and Multiple Oscillators" (A. I. E. E. paper); Prof. J. J. Thomson, on "The Corpuscular Theory"; Prof. L. T. More, on "Electrostriction"; Prof. H. Nagaoka, on "Magnetostriction"; Profs. Drs. Elster and Geitel, on "The Natural Radioactivity of the Atmosphere and the Earth." Abstracts of some of these follow:

COHERER ACTION.—DR. K. E. GUTHE.

A great many different explanations have been proposed for "coherer action." The one which seems to have found the largest number of adherents is that of Lodge, who believes that the metallic surfaces are originally separated by some badly conducting film which may be compressed and partly pushed aside by electrostatic attraction. The film finally bursts and the metal particles are welded together. Lodge has shown that two conductors separated by a film of air 0.00001 cm thick and having a difference of potential of one volt are

attracted by a force of 44 atmospheres per unit area. According to modern theory, free electrons are moving about in the metals in every direction. In the case of a strong external electrostatic field, the electron will be assisted in leaving the metal by increasing its kinetic energy. Thus electrons will be carried over from the metal charged negatively to the other side and there is produced an electric current, carried on entirely by the electrons. As soon as the metals have been brought within molecular range, an increase of the number of electrons, i. e., the current will increase while the difference of potential remains constant. When the electrodes are separated, the dielectric will condense again upon the metallic surfaces and the original high resistance is restored.

THE ELECTRICAL CONDUCTIVITY OF GASES.—PROF. PERCIVAL LEWIS.

The author sums up his conclusions as follows: The conductivity of a gas or vapor seems undoubtedly to depend upon ionization, but in several respects this appears to be different from that in electrolytes. As conduction may take place in an elementary gas its atom must be able to take either a positive or negative charge; the ionic charge is invariable, not proportional to valency; Ohm's law does not in general hold; volume charges of electricity are possible; instead of only two kinds of ions there are several. No doubt the positive carries more toward the cathode, the negative toward the anode, but this cannot result in electrolytic separation of the chemical components in definite proportions, because ions of both kinds and of various magnitudes may exist in both elements.

THE ELECTRIC ARC.—PROF. C. D. CHILD.

The action of the arc may be explained as follows: The current is carried by ions which are produced (1) either within the cathode, because of its high temperature, or at the boundary surface by the impact of the positive ions; (2) through the gas by the impact of the atoms on the negative ions at high temperature; (3) at the boundary surface of the anode by the impact of the negative ions. The electric force must be sufficiently great at the different points, so that the energy transformers will produce the required temperature. Of the facts not explained by this theory, the most fundamental are the ones concerning the action at the boundary surface and the unidirectional character of the ion mercury arc, the behavior of the non-arcing metals and the velocity of the ions in the arc.

THE MAGNETIC EFFECT OF MOVING CHARGES.—DR. HAROLD PENDER.

Maxwell, in his classic treatise on electricity and magnetism assumed that an electric charge in motion produces a magnetic field, a varying electrostatic field produces a magnetic field, a magnetic pole in motion produces an electrostatic field, and a varying magnetic field produces an electrostatic field. Only the first assumption has been experimentally demonstrated, and that only after many years of research by a number of investigators. The paper considers the experimental evidence in favor of the first assumption, shows how this evidence has been obtained and points out a few of the difficulties which have had to be overcome.

ON THE RADIOACTIVITY OF MINERAL OILS AND NATURAL GASES.—PROF. J. C. M'LENNAN.

The paper gives an account of some experiments by Mr. E. F. Burton with a highly radio-active gas obtained from crude petroleum, together with an extension of these experiments and some additional observations made by the writer upon the electrical conductivity of a number of the natural gases of Western Ontario. The results of the investigation show that petroleum and the natural gases examined, when freshly drawn from the wells, were charged to a greater or less degree with an active emanation, which, both in the rate at which its activity died out and in the nature of the induced radioactivity it produced, very closely resembled the emanations dealt with in previous investigations. The author calculates that every five million cubic feet of gas produced by the wells would correspond to the existence of radium at its source of approximately the amount contained in one grain of radium chloride.

THE ABSOLUTE MEASUREMENT OF INDUCTANCE.—E. B. ROSA AND F. W. GROVER.

The preferred method for determining inductance is by operating the coil in series with a resistance which can be varied at will. A current of known frequency is sent through the coil and the resistance is adjusted in value until the fall in potenital across the resistance equals that across the coil. A very simple obvious equation allows of the determination of L. It is necessary to know the shape of the current wave and to make proper corrections for the harmonics. For this purpose the Rosa curve tracer is advantageous. The methods for making the tests and for avoiding errors or correcting for them are given in detail. The results obtained at various times seem to check to within four parts in 100,000. It is suggested that by the use of some carefully constructed inductance standards whose values can be computed from their dimensions, an absolute determination of the ohm can be made.

ON MAGNETOSTRICTURE.—PROF. H. NAGAOKA.

Since the discovery by Joule in 1842 that iron changes its dimensions by magnetization, the magenostricture of ferromagnetic bodies has attracted the attention of experimental and theoretical physicists. A singular characteristic of magnetostriction is its reciprocity with the effects of stress on magnetization of different ferromagnetic substances. The effect of longitudinal stress, of hydrostatic pressure and of twist, on the magnetization of ferromagnetic substances, stands in reciprocal relation with the elongation, the change of volume, and the twist produced by magnetization respectively.

CONCERNING NATURAL RADIOACTIVITY OF THE ATMOSPHERE AND THE EARTH.—J. ELSTER AND H. GEITEL.

Due to the discovery of radium, the well-known property of the atmosphere of slowly discharging insulated electrically charged bodies has received a new significance, and has led to the discovery of radioactivity in connection with atmospheric electricity. The paper gives the radioactivity properties of the atmosphere and the earth which have been found, to date. Many particulars have been learned from incidental observations, but measurements in extremely different climates upon oceanic islands and in the interior of great continents are still entirely wanting. Probably the essential source of the ions lies in the radioactivity of the air, the fundamental phenomenon of atmospheric electricity, the difference in potential between the atmosphere and the body of the earth being but a result of different kinds of ionic concentration in the open air of the ground.

SECTION B.—THURSDAY.

In Section B, on Thursday, the following papers were read and discussed: Prof. H. J. Ryan, "The Design of Insulators"; Prof. E. B. Rosa, Dr. M. G. Lloyd and Mr. C. E. Reid, "The Influence of Wave Shape upon Alternating Current Meter Indications"; Mr. Charles Day, "Electric Motors in Shop Service." Some abstracts are given below:

SOME ELEMENTS IN THE DESIGN OF HIGH-PRESSURE INSULATION.—PROF. H. J. RYAN.

In the design of insulators to withstand high electric pressures the following methods and data are useful: (1) A convenient system of fixing quantitatively the flux electric force produced by an e.m.f. in a dielectric, causing the electric strain therein. (2) The permeability of an insulation to flux of electric force produced by an e.m.f. (3) The density of flux of electric force which the ultimate electric strength of an insulation is called upon to withstand and at which rupture occurs. (4) Expedients that localize the application of the electric strain within those portions of an insulating system that are most powerful and capable of standing the total strain. (5) Experimental methods for testing the dielectric materials to ascertain the proper construction so as to secure their breaking strains, that is, the densities of electric force flux at which their ultimate rupturing strength is developed, and for testing completed insulations or insulators to determine the manner in which they will satisfy the requirements and to determine the design factors. (6) Factors of safety as determined by trained judgment. After discussing each of these topics in detail the author calls attention to the fact that a far less proportionate use of mathematics can be made in determining necessary dimensions in the design of insulation than is the case correspondingly for either of the other two components of electrical machinery and apparatus, viz., the circuits accommodating electric current and magnetism.

ELECTRIC MOTORS IN MACHINE SHOP SERVICE.—CHARLES DAY.

The author considers the subject from the standpoint of the engineer. The motor-driven tool of the future should be not a combination but a unit suited for certain specific ends. When a machine is purchased, the customer should have the assurance that the drive has been given the same care in design and construction as any other part of the machine. Apparatus should be primarily designed to be satisfactory in the hands of average workers. When equipping machines of old design with motor drive, each one should be considered separately, with regard to the special line of work it handles. Systems now on the market for obtaining adjustable

speed are field weakening alone, double commutator motor combined with field weakening, Edison three-wire, unbalanced three-wire and four-wire multiple voltage systems, each combined with field weakening. The conditions which must be met by the machine builders necessitating the selection of a type that does not require for its operation special auxiliary apparatus, are pointed out. While motors operating on two wires and giving a range as high as 4 to 1 by means of field weakening do not at present give as good all round results as those operating on the multiple-voltage and three-wire systems, their adoption by manufacturers is certainly justified in many instances.

SECTION C.—THURSDAY.

On Thursday was held the last meeting of Section C, it being a joint meeting with the American Electrochemical Society. Among the papers presented were those by Dr. R. Lorenz on "The Electrolysis of Fused Salts"; Prof. H. S. Carhart and Dr. C. A. Hulett on "The Preparation of Materials for Standard Cells and Their Construction" (Am. Elec. Chem. Soc. paper); Prof. Dr. W. Ostwald on "Electrolysis and Catalysis"; Prof. J. W. Richards, "The Energy Absorbed in Electrolysis"; Dr. P. L. T. Heroult, "Electrometallurgy of Iron and Steel"; Dr. A. E. Kennelly and S. E. Whiting, "The Present Status of the Edison Storage Batteries." For Friday a joint meeting of the American Electrochemical, the Faraday and the Bunsen Societies was arranged. Abstracts of some of the above papers follow:

ELECTROLYTIC CONDUCTION.—PROF. J. W. RICHARDS.

Faraday divided conductors into two classes. The first class conducted the electric current without decomposition, their conductibility decreased with increasing temperature; they showed no back e.m.f. when the current was stopped. Those of the second class were decomposed when the current passed, their conductibility increased with increasing temperature, and they showed a back e.m.f. when the current was stopped. Since there is no sharp change in electrical conductivity when a metal melts or when a solid conducting salt melts, the author concludes that there is conductivity of the same nature in a fluid salt as in a solid salt and as in a metal, viz., metallic conduction. Electrolysis can be defined as the electrochemical decomposition produced at the points where the electric current passes from a fluid compound conductor to a fluid or solid simple-conducting body or to a solid compound-conducting body, and its seat is the contact surface. Its nature or cause is entirely independent of the manner in which the electricity has been propagated through the body of the electrolyte, and is a function only of the transfer of electricity from the fluid compound to the terminal. The primary cause of the phenomena of migration within the electrolyte is chemical in its nature and not electrical, and is caused by the transfer of the electrical energy at the surface of the electrodes. The migration phenomena in this view are secondary chemical effects of the transfer of the current energy at the surface of the electrodes, and are not in any way phenomena inseparably connected with the mechanism of the transfer of the electric current through the body of the electrolyte.

A STUDY OF MATERIALS USED IN STANDARD CELLS AND THEIR PREPARATION.—PROF. G. A. HULETT AND PROF. H. S. CARHART.

Variations in the e.m.f. of the standard cells have been traced to Hg_2SO_4 used as a depolarizer. It is also well known that standard cells, when first set up, haye a high e.m.f., but in a month or so will settle down to a constant value. Experimental investigation has shown that with proper precautions in the preparation and washing of the Hg_2SO_4, the cadmium cells seem to be reproducible so as to give e.m.fs. varying not more than five parts in 100,000. The important point is the rigid exclusion of the hydrolysed product in either the preparation or the washing of the Hg_2SO_4. The washing with absolute alcohol and ether to remove the acid has many points in its favor, but for some reason the cells so treated give at first an excess e.m.f. of about .00010 and the e.m.f. attains its normal value only after the expiration of a month or more. The paper contains directions for preparing the materials entering into standard cells, particularly the Weston normal cell, with excess of cadmium sulphate crystals, the method of setting up cells, and records the results of observations extending over a period of more than a year.

THE PRESENT STATUS OF THE EDISON STORAGE BATTERY.—DR. A. E. KENNELLY AND S. E. WHITING.

An historical account of the development of the nickel-iron alkaline storage cells from the beginning of the work of Mr. Edison in 1898 to the present date. The first cell, named type C, was put into service in 1900; type D was first completed in May, 1903. A further modification in the cells resulted in type E, the latest type. Each type of cell is described and its performance and defects noted. The characteristics of type E are dwelt upon at some length, while its electrical theory is outlined. The results of numerous tests on the new cells are given. All of the tests show that the cells are remarkable immune from deleterious effects due to careless treatment. Cells have been allowed to dry out, have been permanently short-circuited or even charged in the wrong direction. These cells have shown a full restoration of their capacity after a prolonged restoring normal charge. In its large output at heavy discharge rates, its low depreciation in capacity and its durability under severe and adverse treatment, the cell approaches the capabilities of a piece of mechanical apparatus more nearly than is ordinarily credited to electrolytic structures. For this reason it is specially adapted to automobile service, where the treatment is abnormally arduous and severe.

SECTION D.—THURSDAY.

In Section D on Thursday the following papers were read and discussed: Mr. F. O. Blackwell, "Conductors for Long Spans"; Mr. V. G. Converse, "High-Tension Insulators"; M. H. Gerry, Jr., "The Construction and Insulation of High-Tension Transmission Lines"; Messrs. J. F. Kelly and A. C. Bunker, "Some Difficulties of High-Tension Transmission and Methods of Mitigating Them"; Mr. H. W. Fisher, "Sparking Distances Corresponding to Different Voltages." Abstracts of one or two of these follow:

SOME DIFFICULTIES IN HIGH-TENSION TRANSMISSION AND METHODS OF MITIGATING THEM.—J. W. KELLY AND A. C. BUNKER.

The authors treat of pressure of over 30,000 volts and lines exceeding 50 miles in length. The greatest value of electrical tests is to determine before being used whether the various parts are homogeneous and whether they have been properly cemented together. The locality through which the line passes and the design of the insulator will determine what factor of safety must be used. Trouble from the charring of the wooden pins due to the continued leakage of current over dust-coated insulators may be corrected by placing a metal short-circuit around the pin or by the use of a metal pin. Poles should be treated to prevent decay. Every second or third season the earth should be dug away from the pole for about 18 inches below the ground line and the surface exposed should be freed from decay and be treated. The cost varies from 60 cents to $1.00 per pole. The large number of fatal accidents which have been occasioned by the telephone lines coming in contact with the power wires, would warrant a separate pole line even if the series were no better. The fact that a telephone is seldom of service in times of line disturbance points to the desirability of separate pole lines.

THE CONSTRUCTION AND INSULATION OF HIGH-TENSION TRANSMISSION LINES.—M. H. GERRY, JR.

The paper describes the method of construction and details of design of transmission lines which operate at potentials of from 40 to 60 kilovolts, and deals exclusively with American practice. Typical examples are given of what has been accomplished and what represent successful commercial undertakings. For conductors both copper and aluminum are employed, equally good results being obtained with either metal. For supporting the insulators, pins made of mountain locust from old trees are perhaps the most satisfactory. Steel pins, however, are very reliable. Both wooden poles and steel towers for supporting the conductors as found in current practice are described in detail. A considerable portion of the paper is devoted to the construction of insulators, the work of investigation of Steinmetz and of Ryan, concerning the dielectric strength of air, being reviewed.

CONDUCTORS FOR LONG SPANS.—FRANCIS O. BLACKWELL.

The calculation of long spans is primarily a suspension bridge problem in which all of the mechanical stresses must be fully investigated. The strength of the conductor is at least as important as its conductivity, and the purpose of the paper is to give the results of investigations made by the author to determine the characteristics of conductors so as to secure some definite basis upon which to figure long spans. The available materials, copper, aluminum, iron and steel are described from an experimental standpoint, numerous test data being given. Equations for determining the design of long spans are included, the constants depending upon the physical characteristics of the material being taken from the results of the exhaustive tests made by the author.

SECTION E.—THURSDAY.

Papers were presented in section E on Thursday by Prof. A. Blondel on "Impregnated Arc Light Carbons and Lamps," and Messrs. C. Feldman and J. Herzog on "The Distribution of Voltage and Current in Closed Conducting Networks"; Dr. C. P. Steinmetz on "Luminous Electric Arcs"; Prof. L. Lombardi on "Stroboscopic Observations of the Arc" (A. E. Ital. paper); Prof. E. L. Nichols on "Standards of Light." One or two abstracts follow:

STANDARDS OF LIGHT.—PROF. E. L. NICHOLS.

The conditions demanded of a physical standard are very far from being fulfilled in the case of the existing standards of light, and we are forced by circumstances to content ourselves for the present with finding some seasonably reliable and practical unit. The major portion of the paper is devoted to a discussion of the properties of the amyl-acetate, acetylene and acetylene-hydrogen flames. Rough preliminary trials with apparatus for properly mixing acetylene and hydrogen in proportions which correspond to the condition of minimum sensitiveness to variations have led to the belief that with the same attention to details which has been employed in the development of the amyl-acetate lamp an excellent hydrogen-acetylene flame can be secured. The use of an incandescent solid as a primary light standard would at first sight appear to offer many advantages over any possible flame standard, but the difficulties have thus far been insuperable. The three types of light source available for such a purpose are the incandescent mantle of the Welsbach type, the electric glow lamp and the Nernst lamp. Since the performance of the incandescent mantle depends upon the admixture of certain oxides of the rare earths with the thorium oxide which forms the principal constituent, the satisfactory standardization of the material would probably be found impracticable. The makers of glow lamps have not as yet been able to furnish a filament which will meet the conditions of reproducibility. The use of a filament of the Nernst type as a primary standard has not as yet been seriously considered. While it is probable that the future will see the development of a satisfactory primary standard based upon the electrical heating to incandescence of carbon or of some metallic oxide, the immediate basis for standardization of artificial light sources lies in the use of a primary standard consisting of a flame standard and the preparation of calibrated incandescent lamps as secondary standards of light.

THE DISTRIBUTION OF VOLTAGE AND CURRENT IN CLOSED CONDUCTING NET-WORKS.—PROF. CLARENCE FELDMAN AND JOSEPH HERZOG.

The authors assume first the single case of current being supplied to a single receiver over power lines from two points at separate difference of potential and show that the final current distribution may be regarded as the superposition of the partial distributions, one with load and equal potentials, the other with no load and the assumed unequal potentials. This same principle of superposition may be applied in whole net-works if different voltage or current consuming devices be applied successively. For studying net-works the authors resort to the method of transformation of the net-works or their parts in such a manner that the current and voltage distribution in the rest of the net-work remains unaltered. In most of the practical cases the net-work may be split up into such parts as by themselves may be completely treated by the method of transfiguration.

SECTION F.—THURSDAY.

Some interesting papers were brought forward on Thursday in section F, including Mr. F. B. Behr on "The Monorail System"; Prof. Dr. Rasch on "The Booster Machine in Railway Service and Its Most Suitable Control"; Mr. F. J. Sprague on the "History and Development of the Electric Railway"; Mr. L. B. Stillwell, "Notes on the Electrical Equipment of the Wilkesbarre & Hazleton Railway." The Sprague and Stilwell papers are both valuable contributions to the records of the traction art. An abstract of the Rasch paper is given below.

THE BUFFER MACHINE, OR BOOSTER, IN TRACTION SERVICE AND ITS PROPER REGULATION.—PROF. DR. RASCH.

The buffer machine consists of a large fly-wheel driven by an electric motor whose armature is in multiple with the network. With fluctuating supply voltage the fly-wheel either gains or gives off energy according to whether its change of speed is one of increase or decrease. Thus the motor or generator action of the machine serves to assist in maintaining a steady load on the system. By determining the kinetic energy in the mass of the fly-wheel at one speed and the amount of energy to be given off, the speed to which the fly-wheel will increase can be ascertained. Application of this fact allows the author to calculate the most favorable device for a special assumed case. With single shunt wound machines the fluctuations in e.m.f. would be excessive. By the use of a special exciter driven from the buffer machine, and supplying current to a coil on the field core of the buffer differentially connected with respect to the shunt coil, a change in speed will produce a relatively small change in e.m.f.

SECTION G.—THURSDAY.

A joint meeting was held on Thursday of section G with the Association of Municipal Electricians, when a number of interesting papers were taken up, among which were these: Dr. G. A. Fleming, "The Present State of Wireless Telegraphy"; Dr. Lee De Forest, "Wireless Telegraph Receivers"; Prof. R. A. Fessenden, "Wireless Telegraphy"; Mr. John S. Stone, "The Theory of Wireless Telegraphy"; Marquis Solari, "The Wireless System of the Italian Government"; Dr. Hammond V. Hayes, "Loaded Telephone Lines in Practice." An abstract follows of the Fleming paper:

PRESENT STATE OF WIRELESS TELEGRAPHY.—PROF. J. A. FLEMING, UNIVERSITY COLLEGE, LONDON.

The paper presents a broad, general statement concerning the present state of the art, without offering any special contribution to new knowledge on the subject. So far it may be said that every form of transmitting device in use has involved the employment of an air spark gap, an inductance and a condenser in series with each other, the electrical effect of the arrangement being that a series of high-frequency oscillations are produced in this condenser circuit. At the receiving station an aerial wire antenna has to be erected. The electric waves cut through this wire, and as the direction of their electric force is parallel to it, the moving magnetic force creates an electromotive force in the stationary aerial by cutting through it just as the moving wire of a dynamo has electromotive force generated in it when it cuts across the stationary magnetic field. It may be said that the only plan which has been found to afford a basis for isolation of the communicating stations is that depending upon the employment of the facts of electrical resonance.

The work of the Congress was duly continued on Friday and Saturday, the latter day being reserved, however, for the more formal closing exercises. The details cannot be given here on account of the late hour, and the necessity of closing the forms for press, but to the abstracts already given of papers in the various sections a few are added of interest and importance, including several in Section H on therapeutics, which began the week with a meeting at the Fair grounds.

A CONTRIBUTION TO THE RADIODIAGNOSTICS OF DISEASES OF THE HEAD AND OF THE BRAIN.—PROF. MAURICE BENEDIKT (VIENNA).

The paper records a number of instances when radiographs have been instrumental in detecting abnormal conditions of the head. The photographic effect of Roentgen light is used to determine the difference in penetrability of various positions of the skull. It is stated that the airy parts included in massive bones or separating bones one from another produce a strong effect upon the plate, since the Roentgen light is much diffused by passing through air. Thus from the photographs can be recognized all airy cavities of the skull.

SOME IMPROVEMENTS IN HIGH FREQUENCY GENERATING APPARATUS.—DR. GUSTAVE O'FARRILL.

The conclusions of the author are summed up as follows: It is possible to obtain bipolarity of currents with a single solenoid, by taking the coils of the middle as primary circuit. In the generation of high-frequency currents, one of the poles of the detonator predominates over the other, as is demonstrated by the greater consumption of one of the tinfoil strips. In order to modify the length of the discharge at the resonator, it is not necessary to change the connections of the condensers with the solenoid, for the same result can be reached by changing the length of the spark of the detonator.

RADIATION IN THERAPEUTICS.—DR. G. G. BURDICK.

Late investigators in this field using improved apparatus have stated their belief that the ray has no effect upon disease, and that the early reports of cures were overdrawn. The fault lies in

the technique used by the different operators. It is hardly to be expected that so important a method of treatment could be left to nurses, or be used by men who know nothing of physics or electricity and be successful. The operator should have an exact knowledge of the depth he wishes the ray to pass, so that by adjusting the vacuum of his tube, or by varying the electromotive force upon a tube of suitably low vacuum, it is practicable to pass the ray to the exact depth and have all of the energy absorbed at the place where he wishes the work done. The author states that his experience has developed a technique that is absolutely reliable, and has brought order out of the chaos that existed in this field of work.

X-RAYS AND RADIO-ACTIVE SUBSTANCES AS THERAPEUTIC AGENTS.—DR. EMIL H. GRUBBÉ.

For the cure of cancer, the X-ray has been found to produce excellent results, although the exact mode of action of X-rays upon tissue is still to a large extent a matter of speculation. In experimenting with chemicals for the purpose of augmenting X-ray action upon the tissues, the author found strontium silicate to be the most widely applicable and least objectionable chemical, producing a minimum amount of local irritation and possessing few physiological disadvantages. The application may be external or by hypodermic injection. A saturated solution of strontium silicate in normal salt solution being placed in contact with diseased tissue, the X-ray simply excites the chemical to action, the result from the excitation being appropriated by the cells composing the tissue. This combination treatment will produce results far superior to X-ray treatment alone.

THE PRINCIPLE OF ELECTROTHERAPEUTICS.—DR. T. PROCTOR HALL.

To an electrical engineer the treatment of his subject by the author seems strangely inconsistent as to its nature. After having discussed in detail a certain vortex theory of electricity, assuming the existence of vortex rings consisting of a bundle of chains of polarized and rotating atoms, each chain forming a complete circuit, and by means of this theory, explained the electrical discharge through air and the conduction of electricity by solids and liquids, the author gravely states that from the equation $E = RI$ it appears that the current may be increased by increasing the electromotive force or by decreasing the resistance. Of the several uses for electricity in therapeutics, cataphoresis, etc., the electrolytic conveying of medicants into some particular part of the body seems to have reached the highest stage of logical development.

THE THERAPEUTIC USES OF STATIC ELECTRICITY.—DR. WM. B. SNOW.

The paper discusses the difference between the discharges from a Holtz machine and those derived from a Ruhmkorff coil as used in therapeutics. The general diffusion of the currents from the static machine seems to be more pronounced than from the other source of high potential electricity, the discharges from the machine producing to a more marked degree the raising of the hair and the electric breeze than the discharges from the coil. The diffusion of the static current of such small amperage produces mechanical effects with a minimum of ionic interchange. It is this fact which eliminates all danger. Currents of larger quantity, however, passing through the tissues of the body are certain to produce electrolytic effects, and are destructive to cell life.

SECTION A.—FRIDAY.

ELECTRIC CONDUCTION IN METALS, FROM THE STANDPOINT OF THE ELECTRONIC THEORY.—PROF. P. DRUDE.

The theories of Diecke, Drude and J. J. Thomson for explaining electric conduction in metals are based on the assumption that among the atoms of a metal very small charged particles (electrons) move to and fro like the molecules of a gas, on the kinetic theory. Riecke and Drude assume that there are several kinds of electrons—positively and negatively charged; Thomson postulates only one kind—the negatively charged electrons. The electric and thermal properties of metals in a magnetic field, explained by Riecke and Drude on the assumption that there are two kinds of electrons, seem to be equally as well accounted for by assuming only one kind. This latter form of theory is preferable because it explains the fact that there is no transfer of matter by the electric current in metals. Making certain assumptions in conformity to this theory, the author derives Ohm's law, Joule's law and the connection between the kinetic energy of electrons and the absolute temperature, and discusses the relation between electrical conductivity and temperature, the electrical conductivity of alloys, the relation between the thermal and electrical conductivities (constant at given temperature), the contact difference of potential thermo electricity, the Peltier effect and the Thomson effect.

THE UNOBTAINED WAVE LENGTHS BETWEEN THE LONGEST THERMAL AND THE SHORTEST ELECTRIC WAVES AND THE SHORTEST ELECTRIC WAVES YET MEASURED.—PROF. E. F. NICHOLS.

Our present knowledge of the spectrum as a whole may be summed up in the terms of the wave frequency intervals familiar in music as follows: Beginning with Schumann's and Lyman's short ultra-violet waves, we know about two octaves in the ultra-violet, one in the visible and six in the infra-red spectrum, making nine in all. Here the unknown region begins and the shortest electric waves yet obtained lie above six octaves lower in the scale. The author expresses the hope sometime to undertake experiments with a vibrator consisting of a very great number of small conducting spheres submerged in oil on the bottom of an insulated tray. Suitable electrodes will be introduced at the ends of the tray, and the discharge from the induction coil driven either directly through the layer of spheres, or the equilibrium of the spheres distributed inductively, while the tray is constantly excited. A radiation might be expected not wholly different in character from the emission of a very thin layer of heated solid or liquid. It should be a continuous spectrum between broad limits containing some waves shorter than the natural frequency of a single sphere acting independently. These suggestions are offered with all the uncertainty which must accompany ideas that have not been subjected to actual experiment, and they may be found wholly inadequate, or even false in practice.

CONDENSATION NUCLEI.—PROF. C. T. R. WILSON, F. R. S.

Certain phenomena connected with the collection of moisture in air enclosed in a glass vessel containing water are shown to be readily explained if one supposes that water cannot under ordinary circumstances condense in the form of drops unless suitable nuclei are present to serve as starting points for the drops. It is shown that ions act as nuclei for the condensation of water vapor and that the quantity of electricity carried by each ion may in this way be determined. There are three principal classes of nuclei: (1) the ions proper, requiring a fourfold or sixfold supersaturation to cause water to condense on them, and having a mobility exceeding 1 cm per second in a field of 1 volt per cm; (2) loaded ions requiring little or no supersaturation to make water condense on them, and having a mobility generally less than a thousandth part of that of the ions proper; (3) unchanged nuclei, resembling the second class in requiring little or no supersaturation in order that visible drops may form upon them.

SECTION B.—FRIDAY.

THE REGULATION OF ALTERNATORS.—D. B. RUSHMORE.

The paper gives a summary of work done and the methods commonly used for determining regulation, and the results of very careful tests on widely differing types of machines. After dealing in detail with the processes for determining the resistance, reactance and reaction of the armature, and mentioning the tests for ascertaining the short circuit and open circuit characteristics, the author outlines the methods for calculating the regulation of alternators, by treating the reactance and reaction separately or by combining them into an apparent equivalent "synchronous" reactance and treating the problem as one involving a series connection of the circuits, at least one of which is inductive, or by the magneto-motive force method, or by the Arnold method of resolving the armature reaction into its demagnetizing and cross-magnetizing components. Complete design data and the results of tests on the same machines, from which deductions may be made, rendered the paper exceptionally valuable.

RECENT DEVELOPMENT IN COMPOUND ALTERNATORS WITH ALTERNATING CURRENT SELF-EXCITATION.—ALEXANDER HEYLAND.

The main point of the system devised by the author is that single-phase or polyphase alternating current generated by the machine is led directly to the field windings for excitation and for compounding by means of a peculiar commutator. By the interposition and suitable inter-connection of transformers, or by certain circuit arrangements in a single transformer, the exciting current of the machine is taken off in shunt to the main winding and the compounding current in series, and so conducted to the commutator that the exciting current entering the field winding remains approximately constant for all loads, while the compounding current increases and

decreases with the wattless component of the main current. The armature reaction can be annulled and the drop in voltage compensated for or the machine may be over compounded. In the latest constructions the field winding is divided into groups which are connected to the commutator in parallel to one another. By placing cross connections at the end of the conductors, the current is not interrupted, as was the case in the earlier arrangement, which has been abandoned for practical and constructive reasons. In a recent compounding connection, the polyphase exciting current is generated in three auxiliary coils which are located on the stator. In the same slot in which the auxiliator winding lies, there is placed a part of the main winding, the respective coils being, however, connected in opposite directions to the remaining part of the main winding. With a suitable choice of the number of turns of the compounding coils of the main winding, there can be obtained in this manner a complete compounding without a compounding transformer.

SECTION C.—FRIDAY.

THE SILVER VOLTAMETER.—DR. K. E. GUTHE.

The paper contains a discussion of the precautions taken by various observers to obtain consistent results with the silver voltameter, the amount of deposit per unit current varying with the conditions of the electrodes. The main problem is to prevent the anode solution from reaching the cathode. For this purpose the silver anode is placed in a porous cup. In the use of the voltameter for measuring current it is necessary to assume some value for the electro-chemical equivalent of silver. It seems, however, that while many measurement have been made to determine the absolute value as referred to fundamental units, the results obtained are so far not very satisfactory, and redeterminations are highly desirable.

STORAGE BATTERIES.—GERHARD GOETTLING.

The paper gives an outline of the present methods of installation and operation of storage batteries as practiced by the Edison Companies in the United States. The battery plates, as now furnished, show great improvements over those of previous years. The positive consists of a rigid conducting support, holding in place soft lead buttons of coiled ribbon with corrugated surfaces, these buttons extending slightly beyond the surface of the grid. The negative plate now consists of a hard metal supporting grid in which the various sections of active material are securely held in place by means of a thin covering of perforated sheet lead. An important development is the substitution of thin wooden diaphragms between the plates as separators in place of the glass tubes heretofore generally used. This new separator effectively prevents any possibility of short circuits forming between the plates, thus keeping the cells in uniform condition, and resulting in a very considerable increase in the life of the plates.

ON THE ELECTRICAL PURIFICATION OF DRINKING WATER.—PROF. J. W. LANGLEY.

The most successful method of electrolysis for drinking water is by the use of aluminum plates as electrodes. In a plant in Cleveland, Ohio, the electrolyzer is a rectangular iron box, containing aluminum plates held in grooves in a slate lining, where 300 watts purifies 500 gallons of lake water per hour. Chemical analysis shows the albumenoid ammonia to be reduced upward of 75 per cent. and the bacteria from 97 to 99 per cent. In no instant in six months of continuous commercial operation has a single colon bacillus been found, though the lake water generally contains them.

SECTION D.—FRIDAY.

THE BAY COUNTIES POWER TRANSMISSION SYSTEM.—L. M. HANCOCK.

An outline of the general and controlling features of the system is given, together with a discussion of the organization of the forces to operate the plant and to carry on construction and repair. This system, including that of the Standard Company, being one, embodies the long transmission of 232 miles between the Sierras and San Francisco and other points.

SOME PRACTICAL EXPERIENCES IN THE OPERATION OF MANY POWER POWER PLANTS IN PARALLEL.—R. F. HAYWARD.

The paper describes the operating features of 500 miles of high-tension transmission circuits in Utah. The following points are covered: The organization of the operating staff; the means of communication, the economical distribution of load between steam and water power stations, speed regulations, voltage regulation, arrangement of high-tension lines, switches and transformer stations, and disturbances on high-tension lines due to lighting. The author points out that it would be possible to-day to operate a string of steam and water power plants in parallel from the Atlantic to the Pacific Coast and to supply power to trunk railroads with so few interruptions that train service could be as punctual as it is to-day on steam roads.

SECTION E.—FRIDAY.

THE YORKSHIRE AND LANCASHIRE ELECTRIC POWER COMPANIES.—H. F. PARSHALL.

The author, who is the engineer of these undertakings, describes them as illustration of a numerous class of general supply companies, authorized by Parliament to generate, distribute and sell power over wide areas in England and Scotland. For the edification of those not acquainted with British Parliamentary clauses, the substance of the special powers granted by the act of 1901 to the Yorkshire Power Company is quoted. The paper outlines the circumstances affecting power companies in England, the limitations imposed upon them by Parliament, and the prices obtainable, having regard to the size and extent of user, and describes the most economical type and arrangement of plant to meet the conditions obtaining. It is stated that these undertakings, if carried out on the basis outlined, can be made remunerative from the commencement, and that beginning with a 6,000-kw plant, there is sufficient margin to show a satisfactory return on the capital.

A STUDY OF INTEGRATING ELECTRIC METERS.—C. D. HASKINS.

Integrating meters may be classified as coming within six family groups, namely: (1) Electrolytic meters—Devices dependent upon electro deposit, varying with the current, and leaving a permanent record of the total number of units passed. (2) Thermal meters—Devices which utilize the variation of heat corresponding to the variation of current. (3) Clock meters—Meters consisting of a clock with an escapement so constructed as to vary the speed of the clock. (4) Relay meters—Devices combining a constant speed mechanism with a governing mechanism which may consist of any form of indicating instrument, the indicating device determining the number of revolutions made in a given period by the actuating mechanism which does the mechanical work. (5) Variable transmission meters—Devices consisting of a constant speed mechanism, either clock or motor, with a transmission mechanism varying the ratio of motion between the constant speed mechanism and the recording mechanism. (6) Electrodynamic meters—Motors of various forms designed to vary in speed in accordance with the changes in the rate of delivery of energy through their windings. Each group is treated at length.

SECTION G.—FRIDAY.

THEORY OF TELEPHONE-EXCHANGE DEVELOPMENT.—G. DE LA TOUANNE.

The paper discusses the principal commercial questions met in starting a new telephone exchange. Having stated a few laws concerning the variation of expenses with the number of subscribers, and estimated the maintenance and depreciation rates for the several portions of the equipment, the relation between the different variables is expressed in equations. It is suggested that by the use of a system of sewers or by the payment of a small rent for municipal or private subways, the telephone enterprise will be able to reduce rates very appreciably.

FEATURES OF THE TWO-STRAND COMMON-BATTERY SYSTEM.—PROF. J. C. KELSEY, PURDUE UNIVERSITY.

After reviewing the improvements introduced from time to time in telephone equipments, the author relates the facts of development which led to the invention of the first double supervisory, two-strand telephone system. The difference between the Dunbar and the licensee system, which it resembled in many minor details, is pointed out. There is a great difference in the electrical actions involved, necessitated by the use of a talking strand as the means of operating the cut-off relay, and acting as a test terminal in addition to its natural function. The test feature is a distinctive one, consisting of a 5,000-ohm relay whose armature contacts when closed put a ground on the primary circuit in such a manner as to cause a battery current to flow through the primary winding and induce a current in the secondary. Each system has a normally disconnected jack, a normally connected line-signalling apparatus, and is designed for metallic service only, the difference being in the removal of the ground from the subscriber's station to the exchange cut-off relay terminal.

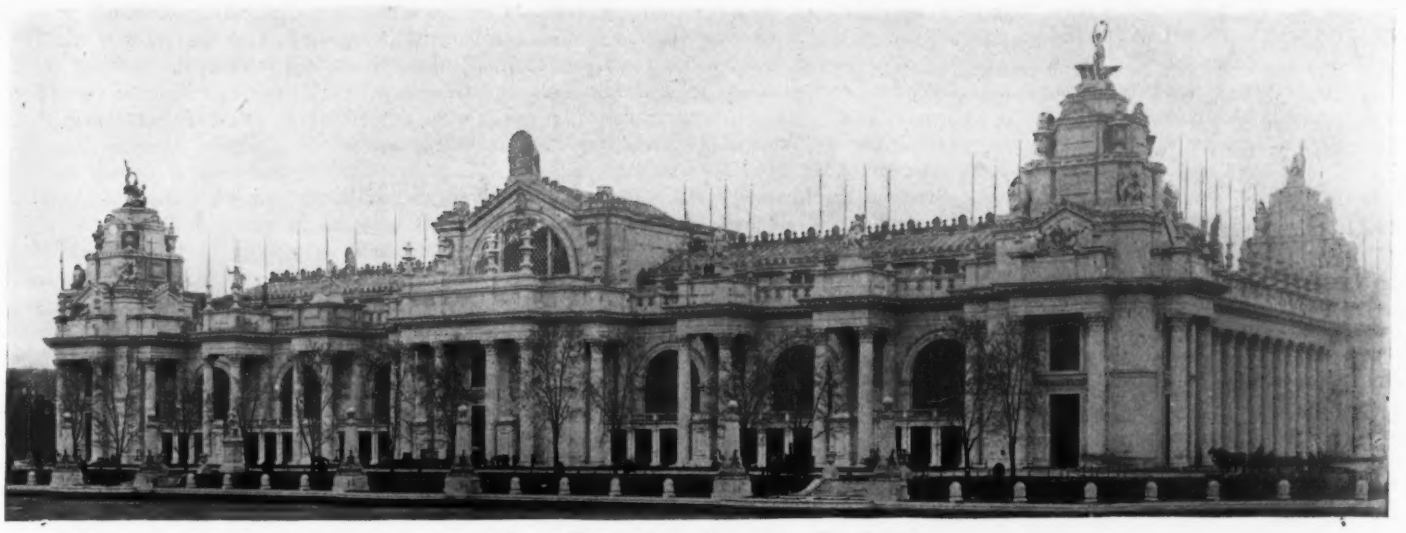


FIG. 1.—ELECTRICITY BUILDING, ST. LOUIS.

The Tour of the Foreign Engineers and the Electrical Congress.

THE record of the reception of the electrical engineers from abroad in this country closed in these pages last week with the arrival of the special Institute train at Montreal on the morning of September 7.

When the special train bringing the delegates arrived the visitors were conducted to headquarters in the Windsor Hotel by members of the local reception committee. Each delegate was required to register in a special book and then received a badge, composed of a neat bronze button and a ribbon bearing the number corresponding with the name of the delegate in the register and on the printed programme. The badges also, it is said, should have entitled the visitors to a free use of the cars and telephones of Montreal during their visit, but many were made to pay fares by the conductors.

At 10 o'clock the delegates, accompanied by Montreal electrical men, went to Lachine, a port on Lake St. Louis, on a special train provided by the Grand Trunk Railway. At Lachine, a steamer provided by the city of Montreal, was in waiting to take the delegates down the famous Lachine rapids.

Just as the boat left the dock Alderman Sadler, who represented Mayor Laporte, extended an official welcome to the visitors from the pilot house of the boat. "I extend to you on behalf of the city," Alderman Sadler said, "a hearty welcome to Montreal. I regret that our Chief Councillor could not attend in person, but he has instructed me to make known to you the kindly feelings which Montreal holds on your behalf. We feel honored that you are spending two days with us. Montreal is proud of her electrical activity. She is making all possible use of electricity and hopes in future to further utilize the vast natural power lying to her hand. We trust that you will thoroughly enjoy your sojourn with us." The steamer had been prettily decorated for the trip and the delegates were delighted with the exhilarating cruise.

The party landed, at noon, just below the main receiving substation of the Montreal Light, Heat & Power Company, where they were entertained at luncheon by the directors of the company.

The guests were met at the sub-station by Senator Mackay, a director of the company; Mr. H. H. Henshaw, secretary, and others of the officials.

The luncheon was a novel one. Served in the large power house of the station, the guests ate amid the roar and whir of the great machinery that manufactures the light and heat and power of Montreal. The appropriateness of the setting was noted by many of the guests, but they could not hear much of the speeches.

Following President Gray, Professor Ascoli spoke in Italian for his countrymen and the other foreigners present, and briefly returned thanks for the hospitality of the hosts, expressing the appreciation of his fellows. Mr. Bion J. Arnold, president of the Institute, when he arose, followed the example of the British president in the use of his hands. He trumpeted: "This is, honestly, the first time in my life that I have found myself placed in competition with an electrical power plant as a noise maker, and it reminds me of a remark made by Senator Chauncey Depew, who, when he was asked to speak over the telephone from Washington, to a gathering of the Transportation Club, began: 'I have been charged with making speeches of tremendous length, but never before have I offended with one 250 miles long.' (Laughter.) "However, I can only reiterate the sentiments of my friends and say that my confreres and myself are delighted with our visit in Montreal. We, as neighbors and friends, naturally are more in touch with your work than some of our friends here, and we appreciate your progressiveness and activity. On behalf of my fellow-countrymen I thank you."

A toast to the King was taken with the National Anthem. On the conclusion of the luncheon, street cars, provided by the Street Railway Company, took the visitors, under the guidance of Alderman Sadler, around the city and over the mountain.

At 4.30 a reception was held in the Macdonald Engineering Building at McGill University. The drawing-rooms of the building were tastily decorated, and the guests, nearly all of whom attended, were received by Mr. and Mrs. Frank Redpath, Mrs. C. J. Fleet and Prof. Owens.

The evening was spent at Dorval, a resort on Lake St. Louis, some miles out of the city, on the beautiful grounds of the Forest and Stream Club. A special train loaned by the Grand Trunk, conveyed the guests to the vicinity of the club.

The entire grounds were decorated with lanterns, and a large searchlight, stationed on the roof of the clubhouse, lit up the lawns and lake shore. The guests, including many well-known society people from Montreal, were received by the members of the reception committee and passed out to the rear lawn. Suddenly a surprise came. Far out on the lake sounded an Iroquois war song and soon into the range of light a great war canoe, with 20 Caughnawaga Indians, bounded. The redmen landed and assembled on the lawn and there, to the great delight of the visitors, danced the war dance, the spirit dance, and performed the marriage ceremony and chief electing ceremony of the old Iroquois. The Indians then sang the tribe songs, danced to the strains of "Navajo" and completed their entertainment by singing "God Save the King" in their native tongue.

A visit to the plant of the Shawinigan Falls Water & Power Company, at Shawinigan Falls, some seventy miles from Montreal, was the chief feature of the second day's programme for the entertainment. About ninety of the visitors took advantage of the opportunity to view the Falls and at 8 o'clock they boarded a train provided by the Northern Pacific Railway. The train arrived at Shawinigan Falls shortly before noon and the delegates were received at the station by Mr. Albred, secretary of the Power Company, and Mr. Wallace, chief engineer. The guests were conducted to the dining rooms of the local hotel where luncheon was served. Mr. Albred, speaking for the president and directors of the company, welcomed the visitors warmly and then, assisted by Mr. Wallace, he imparted considerable information of interest concerning the power plant of which he is a director.

After luncheon the guests were taken over the plant. The Falls were the first point to be visited, and they drew forth a great deal of interesting comment. Higher than Niagara, they have not the same volume behind them, but with the present equipment they supply 15,000 hp with an 84-mile transmission, and the company is now conducting operations to increase the production by 20,000 hp.

The immense chute which conveys the pulp logs from the stream to the mills was inspected and found exceedingly interesting. Then the real point of interest was reached, in the power house itself. The officers of the company were kept busy answering questions and the visitors were highly pleased with the trip.

While the party referred to above were spending the day at the Falls, the remainder of the delegates were entertained by Mr. H. D. Bayne, secretary of the reception committee. Starting shortly after breakfast the party was taken for a coaching trip in thirteen tallyhos to the grounds of the Montreal Hunt Club, a few miles from the city. The drive lay through some of the most beautiful of the scenery surrounding Montreal and the visitors enjoyed it immensely. Returning to the city for luncheon, the party was then taken to the power house of the Lachine Rapids Hydraulic & Land Company, where the plant was thrown open for their inspection. Officers and employes of the company took the delegates in hand and conducted them over the buildings and power houses.

The presidents of the American, British and Italian Institutions, Messrs. B. J. Arnold, R. K. Gray and Moisé Ascoli respectively, and Professor John Perry and the Misses Perry and A. Stower and Dr. Glazebrook were guests at dinner of Mrs. and Mrs. Frank Redpath at their home, "Inglenook," Ontario Street. The delegates left Montreal at 8 o'clock in the evening by their special train over the Canadian Pacific Railway for Niagara Falls.

The trip from Montreal to Niagara was made at night time, and was quite uneventful. The morning found the party nearing the greatest power development in the world, and, naturally, on leaving Buffalo everybody was interested in the Niagara River. The entrance to the river at the foot of Lake Erie, its rapid current at that point, and its broadening out farther down stream were features of much interest, and the foreign members of the party could hardly wait until Niagara and its wonderful scenic and industrial features were reached. Those members of the American Institute of Electrical Engineers who were familiar with the river and its wonders explained the situation of the water supply, so that on reaching Niagara all were quite thorough in their understanding of the reservoir and stream that feed the turbines of Niagara.

It was 10.30 o'clock when the special train reached Niagara, an hour and a half behind schedule time. The train stooped at the Falls Street Station, and there all alighted and boarded electric cars on the Great Gorge road, which were most conveniently in waiting at the Second Street entrance to the depot yard. The morning was delightful, and the bits of information the foreign members had gleaned about the beauty of Niagara made them anxious to get away and view the wonders. The local reception committee, consisting of George W. Davenport, as chairman, and E. G. Acheson, C. E. Acker, H. B. Alverson, P. P. Barton, H. P. Bissell, H. W. Buck, J. C. Calisch, W. R. Campbell, Newcomb Carlton, Orrin E. Dunlap, W. Caryl Ely, A. Monro Grier, Elwood Grissinger, C. M. Hall, J. M. Hancock, G. A. Harvey, F. W. Haskell, A. C. Hastings, C. R. Huntley, T. E. Mitten, J. E. Montague, E. F. Price, DeLancey Rankine, A. Schoellkopf and C. W. Underwood, was in waiting. They were quick to greet old friends, while the numerous introductions established new friendships.

The trip through the gorge was just a bit contrary to the method accepted as the best, for it carried them first down the Gorge route, the cars running in the same direction as the water, and following the inside track, passing cars every now and then, interrupting the view. Whereas, if they had gone down the Canadian side first they would have had the river track all the way down and up, and in coming up would have been running against the mighty currents of the mysterious river. Still, the necessities of the time at Niagara made this programme advisable. They saw the whirlpool rapids, the famous whirlpool, and all the features of the gorge. The picture was never better, and the views were impressed on the memories of men from the loveliest regions of Europe, who will go back to their own countries realizing that America has its beauty spots.

At Lewiston, the trolley cars crossed to the Canadian side by way of the suspension bridge. Queenston Heights were seen, and the history of the locality was told. The run back up toward the falls was made over the tracks of the Niagara Falls Park & River Railway, the party going direct to Victoria Park, where ample opportunity was given all to make a complete inspection of the works of the Canadian Niagara Power Company, those of the Ontario Power Company, and also those of the Toronto & Niagara Power Company. They saw that the plant of the Canadian Niagara Power Company was furthest advanced. The wheel-pit of the Toronto & Niagara Power Company is being sunk, and the big steel flume of the Ontario Power Company is nearly completed.

Turning from the Canadian developments, the route carried the party over the upper steel arch bridge. The cars ran direct to the International Hotel, where lunch was enjoyed. After lunch, little side and individual trips were made down to Prospect Park, to Goat Island, and up on the fascinating steamer "Maid of the Mist." Within an hour, the party had again gathered, and all went to view the installations of the Niagara Falls Power Company, some having previously gone to see the station of the Niagara Falls Hydraulic Power & Manufacturing Company. In both of these stations every courtesy was shown the guests, and every facility offered for a thorough inspection. After the big power houses of the Niagara Falls Power Company had been inspected, there was a coming together on the terrace over the forebay structure, where light refreshments were served.

That the local committee of Niagara Falls had carefully prepared for the coming of the visitors was clear from the handsome souvenir volume presented each of the guests; also in the fact that the special train was run right down to the power house No. 2 over the tracks of the Niagara Junction Railway. This was the first time this had ever been done, and it was a convenience that made it possible for the engineers to linger to the last moment amid such instructive and fascinating surroundings. It was about 5.50 o'clock when the train was boarded at the power house. Thence it ran down to the Falls Street Station, from which point it left at 6 o'clock p. m. for Chicago.

The reception and entertainment of the visitors by the Chicago committee was carried out with a method and a thoroughness characteristic of that city. Messrs. Niesz and Scribner of the local committee met the party at Niagara, and on the train to Chicago they welcomed the visitors and handed to each an engraved invitation to become the guest of the local committee, together with a neat pamphlet containing an outline of the programme for the day in Chicago. Each member was requested to indicate on a detachable card on this pamphlet his choice of the various tours arranged for and explained in the pamphlet. When Chicago was reached, shortly after 7 o'clock Saturday morning, the visitors were taken to the Auditorium Annex, where the parlor floor and rooms for all had been engaged. After breakfast some 40 or 50 automobiles were boarded and trips were taken to various places. Most of the party went to the new Fisk Street station of the Commonwealth Electric Company to see the three 5000-kw turbo-generators in operation there. The main exchange of the Chicago Telephone Company, the tunnels under the city, the harvester works, the big retail stores and many other points of interest were visited. In the afternoon some of the party were taken through the parks and boulevards in automobiles, while the rest enjoyed a trip on Lake Michigan in the U. S. S. Dorothea, the training ship of the Ilinois Naval Militia.

As many of the travelers were somewhat tired from the exertion of the previous days, the evening dinner in the Palm Room of the hotel was made thoroughly informal with no set speeches. At the close Mr. Samuel Insull, chairman of the local committee, expressed the deep gratification of himself and his associates at the coming of the visitors to Chicago. A few short and happy remarks of appreciation were made by President Gray, Colonel Crompton and Professor Perry for the British, by Signor Ascoli for the Italians, and by President Arnold and Mr. Lieb for the A. I. E. E. The spirit of comradeship was evidenced by the singing of the national airs and other songs. With the words of "Auld Lang Syne" on their lips, the party broke up to return to the train. A delightful and strenuous day in a delightful and strenuous city was ended.

The story of the day's visit would not be complete without mention of the excellent work done by the local committee. To the untiring efforts of Chairman Insull and Messrs. Ferguson, Niesz, Junkersfeld, Gaylord, Edkins, Berry, Scribner, Sunny and others is due the fact that the excellent programme with its many and varied special trips was carried out promptly and without a hitch.

At the Illinois capital, Springfield, the party stopped to visit the tomb of the great American president and martyr. After breakfast given by the Citizens' Association at the Leland Hotel, trolley cars took the party to Oak Ridge Cemetery. At the National Lincoln Monument, addresses of welcome were delivered by the Mayor, by Chairman Ridgely of the Citizens' Association, and by Governor Yates, who dwelt upon the life and character of Abraham Lincoln, and who congratulated the visiting engineers upon being, like Lin-

coln, men "who do things." After short responses by Presidents Arnold, Gray and Ascoli (the latter in Italian) the party returned to the train and continued on to St. Louis. The World's Fair city was reached at 2 o'clock and the party was taken directly to the Jefferson Hotel.

The special party did not have many hours in St. Louis before the International Electrical Congress began, and then it became merged in the gathering of some 600 members of that body, assembled from the four quarters of the globe to participate in that important convention. The St. Louis local reception committee, of which Mr. Powelson was chairman, then began its courtesies which extended through the week. The programme included an informal reception at the Hotel Jefferson, on Saturday evening, September 11; on Monday evening a formal reception at the New York State Building on the Fair grounds; on Wednesday the celebration of Electricity Day at the Fair; on Thursday, St. Louis Day at the Fair, and other special functions, the ladies being taken care of in the meantime with special entertainments, including automobile rides As in other cities, a special and interesting handbook was issued by the local committee which comprised Messrs. W. V. N. Powelson, J. I. Beggs, M. Carleton, E. G. Cowdery, S. M. Dodd, G. F. Durant, W. E. Goldsborough, S. M. Kennard, W. A. Layman, R. McCulloch, W. F. Noelker, G. Pantaleoni, H. L. Reber, G. D. Rosenthal, R. Scudder, J. E. Smith, E. J. Spencer, G. Swope, A. Warren and J. S. Walsh, the special committee of arrangements being W. A. Baehr, H. H. Humphrey, W. A. Layman, A. S. Langsdorf and W. V. N. Powelson.

During the week there were necessarily a number of other public and private functions connected with the Congress, of which but a brief enumeration can be made here. On Tuesday, Mr. Bion J. Arnold, as president of the Institute, gave a dinner to the delegates, and the Congress officers gave a dinner to the delegates on Thursday. Mr. George Bullock, on Thursday, also gave a luncheon. Mr. H. Ward Leonard gave a dinner on Wednesday. The reception by the exhibitors to the Congress was a great success, all the exhibits of electricity and electrical machinery on Wednesday night being in full operation until ten o'clock. On Friday the British Commissioner gave a reception at the British Pavilion, and in the evening the St. Louis local committee gave a dinner at the German Pavilion. On Saturday President Gray, of the British Institution, entertained a large luncheon party at the New York State House. There were many other social events of a pleasant character tending to make the week in St. Louis memorable for all who attended the Congress, and especially for the visitors from abroad. It is needless to say that Electricity Building was the great centre of attraction all the week, with Machinery Hall not far behind, both finding an active rival in the Pike. In Electricity Building the Institute headquarters were freely used, while another rallying point was the cosy exhibit space of the McGraw Publishing Company and ELECTRICAL WORLD AND ENGINEER.

During the week there were conventions of the National Electrical Contractors' Association, the Association of Municipal Electricians and the Northwestern Electrical Association, but these were all more or less merged in and closely associated with the great Congress.

The programme of the circular tour will land the visitors in Pittsburg Sunday afternoon, September 18, and several excursions have been arranged for Monday under the direction of Mr. C. F. Scott, chairman of the local reception committee. The visits include the Westinghouse Electric & Manufacturing Company's plant, the Westinghouse Machine Company with its steam turbines; the Union Switch & Signal Company, with its electro-pneumatic signalling devices; the Westinghouse Traction Brake Company, with its brakes for electric cars; the Nernst Lamp Company, and the works of the Carnegie Steel Company. Certain routes will allow visitors to spend most of their time in a few of the works; others will give them a rapid tour through all. It is expected that all will congregate at the works of the Westinghouse Electric & Manufacturing Company in the early evening for supper and informal reception, and that the guests will depart from the East Pittsburg station of the P. R. R.

FIG. 3.—ONE OF THE HEADQUARTERS.

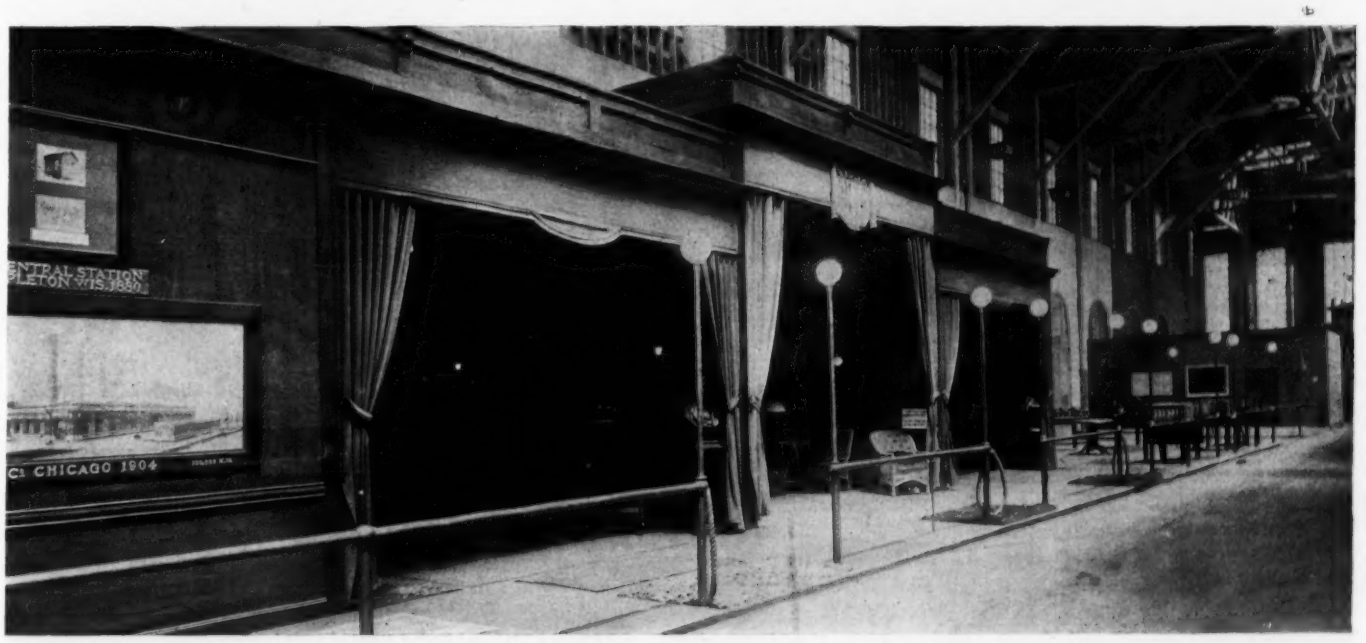


FIG. 2.—HEADQUARTERS AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, ELECTRICITY BUILDING.

"On to Washington!" is next the cry, and at the capital the special train will be met on Tuesday morning by Gen. G. T. Harries and a strong local committee. The morning will be taken up with the opening exercises at the new building of the National Bureau of Standards. From that point the visitors will go to the Congressional Library, where luncheon will be served, and where prominent residents of the capital will greet the visitors. For the afternoon a

number of trip are arranged, but it is expected that the great majority will want to visit the home of Washington at Mount Vernon. The next day, Wednesday, will be spent in Philadelphia, where Mr. J. B. McCall is chairman of the local committee. The party will visit the Edison power houses, the Baldwin shops, Independence Hall and other conspicuous places, and will be entertained at lunch, leaving in time to reach New York in the evening. On Thursday a special train is to take the English contingent to the Edison Laboratory at Orange, where they will be entertained by Mr. Edison at lunch, leaving in time to visit the Crocker-Wheeler works for afternoon tea on the way back to New York.

New Telephone Patents.

A NOVEL TELEPHONE TRANSMISSION CIRCUIT.

Mr. W. W. Jacques, of Boston, has brought forward a most interesting telephone line construction, designed for long-distance working, by which it would seem that the telephonic range may be greatly extended. The system is based upon what may be termed distributed shunts. It is founded upon the mathematical condition for distortionless transmission of electrical wave; that is, the condition for an equal velocity of transmission for all pitches. The mathematical considerations laid down in the specification for patent are most interesting, but a review of them here seems unprofitable. Suffice it to say, that if copper wire can be given some magnetic properties, the system of shunts may be of so high a joint resistance that they will not shunt the line sufficiently to disasterously diminish the volume. Mr. Jacques finds that by plating copper wire with nickel, with iron, or with an alloy of these, he can suitably increase the magnetic properties, without affecting much the resistance or capacity constants. For shunts graphite pencil marks of 36,300 ohms resistance each will suffice. For aerial lines of No. 12 copper the thickness of nickel plating required is given as one-hundredth of an inch, when the wires are twenty inches apart and provided with one shunt every ten miles. Such a line will apparently serve for a 1,000-mile transmission. Similarly a cable of No. 20 gauge copper in twisted pairs and each wire plated properly and shunted once every mile, will suffice for a 100-mile circuit. A further advantage claimed is that this system is largely indifferent to line leakage, while the previous Pupin system is extremely sensitive to this almost unavoidable effect.

MASTER KEY FOR PARTY LINE RINGING.

Messrs. J. W. Lattig and C. S. Goodum have patented a master key for controlling the ringing current supply for operators' keyboards. With a master key scheme, each cord is provided with but one ringing key and the current supply to the keyboard is controlled by the master key, that variety of current for any kind of selective signal being connected to the ringing keys as desired. The new master key is provided with a magnetic lock, which prevents it being shifted during the act of ringing, and therein ties the improvement. The Eastern Telephone Manufacturing Company has been assigned the patent.

TRANSMITTER FOR THE DEAF.

The use of the telephone by the deaf seems to be upon the increase, and there is a demand for more efficient and convenient instruments. The latest improvement in such apparatus is a transmitter made adjustable and especially designed to be sensitive to sounds spoken at a distance from the mouthpiece. A perforated front plate protects the diaphragm. The transmitter is designed to be hung upon the breast of the user. C. W. Harper, of Malden, Mass., is the inventor.

TELEGRAPHING BY TELEPHONE.

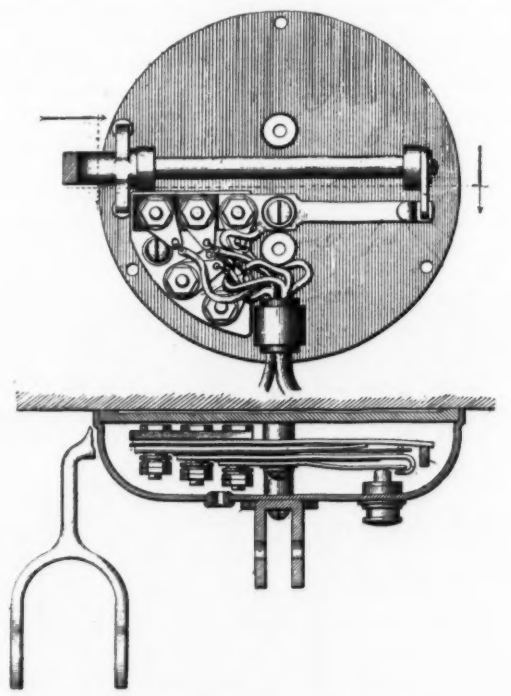
Telegraphing by telephone is a rather odd combination, yet such is a process which has been patented by E. W. Day, of Baltimore. It is the inventor's idea to provide a telegraph system such that it may be operated by unskilled persons. As may be inferred, the telephone serves as a receiving instrument and the messages are spelled out in it. The transmitter is operated through a keyboard similar to that of a typewriter. The keys of this serve to apply a reproducing stylus against a phonogram, which bears a phonographic record of the desired letter. The stylus agitates a telephone transmitter through which the receiver is affected.

TELEPHONE LOCK.

That the coin-actuated telephone lock has been developed into a very comprehensive mechanism, is revealed by the specification of a patent for improvements, recently granted to R. W. Goeb, of St. Louis, and assigned to the Controller Company of America. The type of lock in question is designed to secure the receiver upon the telephone hook until the lock is released. There is provided under various patents means for automatically locking the receiver when it is returned to the hook, and yet at the same time permitting of vertical motion of the hook; means for the return of a coin in case a call fails, and also means for releasing the receiver without prepayment for an incoming call. Both of these latter functions have heretofore required the movement of a hand switch by the telephone user. The present patent describes an attachment to the ringer, such that the ringing of the bell by the operator will perform the switching. The ringer attachment consists of an auxiliary armature mounted so as to be unaffected by the polarizing magnet and at the same time so as not to interfere with the operation of the regular armature. The switch closes the controlling circuit and the position of the lock determines which of the two functions, the unlocking or coin-returning, is performed.

SUB-STATION APPARATUS.

A subscriber's set suitable for hotel and interior systems has been invented and patented by F. R. McBerty, of Chicago. Contrary to usual custom, the hook switch is actuated from an oscillating shaft, and, therefore, the casing may be sealed. Fig. 1 gives two part sections showing the operation. The Western Electric Company



M'BERTY SWITCH.

has been assigned this patent. A second patent of this class deals with a special form of hook switch, in which the switching member is made up of slip springs, after the manner of a ringing key. The patent especially relates to the provision of positive stops for the free members, lest they overtravel and cause trouble. C. T. Mason, of Sumter, S. C., is the inventor.

TRANSMITTER.

In order to make use of all the vibrations of the diaphragm of a transmitter, assuming that this vibrated with a series of nodes and loops, J. W. Kurtz has designed a transmitter in which a considerable number of inclined and resilient links, spaced over the whole surface of the main diaphragm, convey its motions to the microphone button. One electrode of this is a thin plate of carbon upon which the whole energy of vibration is received. The rear electrode of the button rests upon a third diaphragm. This construction is certainly novel, but no more so than the transmitter casing, which, instead of the shallow air space before the diaphragm, provides a great resonating chamber.

CURRENT NEWS AND NOTES.

ENGINE BUILDERS' ASSOCIATION.—The next meeting of the Engine Builders' Association will be held at New York, December 2 and 3 next. Mr. J. I. Lyle, New York, is secretary.

ST. LOUIS-CHICAGO WIRELESS.—It is stated that Dr. Lee De Forest succeeded on Sunday, September 11, in establishing very successfully between Chicago and the Exposition at St. Louis, wireless telegraphic communication. A large quantity of news material and congratulations was interchanged.

THE STATUE OF LIBERTY, in New York Bay, has been allowed to fall into a neglected condition, but now better things are promised. The reserve popular fund of $40,000 or more has been turned over to the War Department, and under its new caretakers the statue is to have better treatment. It is to be cleaned, the tablets are to be renovated, the walls repaired, and an electric passenger elevator is to be installed in place of the wooden stairs inside the great figure designed by Bartholdi.

CIVIL ENGINEERS IN CANADA.—The British Civil Engineers now visiting this city will make a trip to Canada next week, en route for St. Louis. Montreal will be one of the points in the tour, including the Lachine power development and McGill University. At Quebec they will visit the Montmorency Falls plant of the Quebec Railway, Light & Power Company. At Ottawa, they will visit the Chaudiere Falls, and make trips over the Ottawa Electric Railway and the Hull Electric Railway. From Toronto they will proceed to Niagara Falls.

AN ACCURATE TIMEPIECE.—The best timekeeper in the world is said to be the electric clock in the basement of the Berlin Observatory, which was installed by Professor Foerster in 1865. It is enclosed in an air-tight glass cylinder and has frequently run for periods of two or three months with an average daily deviation of only fifteen one-thousandths of a second. Astronomers are making efforts to improve even this and to secure ideal conditions for the clock by keeping it not only in an air-tight case, but in an underground vault, where neither changes of temperature nor of barometric pressure shall ever affect it.

A TROLLEY MILK ROUTE.—The State Line Traction Company, of New Jersey, has acquired enough property in Passaic, Sussex and Warren Counties to complete a trolley line from this city to Suffern, N. Y. The line is to be used almost exclusively for the transportation of milk from places in these counties and in Orange and Rockland Counties, N. Y., to Paterson and thence by the Hudson River Trolley Company to New York. This is following out an idea that has been successfully tried in some Western States by the men who have formed the State Line Traction Company. Eventually, it is said, the line will be run to Easton, Pa.

WEATHER NEWS BY WIRELESS.—An experiment is to be made in Great Britain which is expected to lead to a material improvement in the weather forecasts for the United Kingdom. Through the enterprise of *The Daily Telegraph,* wireless messages are to be secured from ships at sea concerning the force of the wind and the reading of the barometer at points not more than a hundred miles from the western and southwestern coasts. This information, when combined with the government reports relative to conditions on land, is expected to furnish indications of an approaching change which might not otherwise be foreseen. Unfortunately, such reports will not change the English climate.

SUBWAY FOR CINCINNATI.—Plans have been made under the direction of the Union Terminal Company, which, if carried out, will give Cincinnati one of the largest railway subways in the country. They will be submitted to the various railroad authorities at once, and it is believed they will be accepted. The plans include a subway directly across the centre of the city. Private property is to be taken by purchase and lease, giving those along the line direct switching connection with every railroad in the city. The tunnel will be arched overhead, the construction being strong enough to support business houses. It will contain twelve standard tracks. The motive power will be electricity and both freight and passengers will be hauled.

TELEGRAPH LINES IN ALASKA.—Brigadier-General A. W. Greely, the chief signal officer of the army, has returned from Ottawa, where he went to consult with the Canadian authorities in regard to the exchange of messages between the Canadian telegraph lines and the American telegraph lines in Alaska, it being desired to obtain harmonious co-operation of the two systems. The submarine cable from Seattle, Wash., to Sitka, Alaska, has been laid, and is in working order, but the Canadian lines still have to be used with this cable to connect the land system in Alaska. When the cable is laid between Sitka and Valdez (Fort Liscum) an all-American line will be in operation. It is expected that this line will be in operation by the middle of October.

REGULATOR FOR ALTERNATING-CURRENT GENERATORS.—In order to maintain a practically constant pressure regardless of the nature and value of the load upon the alternator, Mr. Ludwig Gutmann, according to a patent issued September 6, employs certain relay devices for adjusting the field strength of the exciting dynamo. The exciting generator is supplied with two field windings, a normal shunt coil and an adjustable series (or differential) coil. The load current from the exciter passes through more or less of the series turns on the field cores of this machine and through the field coils of the alternator. The excitation of the alternator will depend, therefore, upon the adjustment of the number of series turns on the exciter generator. The number of series turns in circuit is determined by the mechanical position of a slide upon contacts connected to the field turns, which position is regulated by a centrifugal fly-ball governor driven by a motor whose speed depends upon the voltage of the alternator.

ELECTRIC MOTOR TESTS.—Mr. Arthur Williams, of the New York Edison Company, reported some interesting motor tests to the recent Edison convention at New Castle, N. H. Exact figures upon the average use of various types of lighting and power installations offer an element of information of the greatest value in the sale of electric current. In twelve large buildings in New York City, the average daily use of each installed lamp in a recent year was 3.22 hours, ranging from 14 per cent. below the average to 58.7 per cent. above. Of five large New York clubs the annual use averaged 4.75 hours, the range being from 22 per cent. below to 16 per cent. above the average. For motors in smelting works the average use was .48 hours for each horse-power of the rated capacity; instrument makers, 3 hours; machine shops, 2.1 hours; general machinery, 4.56 hours, etc. The average of fifty motors was 2.26 hours per day for each rated horse-power. Tests show that the cost of operating ceiling fans on the basis of 10 cents per kilowatt hour is 1.58 cents. For driving sewing machines the cost is .35 cent for belt-driven machines, and .2 cent for direct-connected machines. The results of tests are also given for printing presses, rock drills and fire pumps.

MEASURING INSTRUMENTS.—At the convention of Edison Illuminating Companies just held, Mr. C. D. Haskins read a paper entitled "Measuring Instruments for Generating and Sub-Stations." The most noteworthy change between the practice of to-day and that of ten or fifteen years ago is found in the disappearance of instruments intended for direct connection to the system. This development in the art has resulted from the tremendous increase of current values on the one hand and from the much higher potentials. This condition has led to the almost universal use of ratio devices—shunts, in the case of direct-current systems; current transformers, in the case of alternating-current systems. The conditions of to-day demand a current transformer having substantially a straight line ratio for a considerable range of load, which means current transformers and instruments which are interchangeable. This problem has been solved, it having been found practicable to achieve the desired results through a range of 10:1, which is ample in connection with all indicating instrument problems, since indicating instruments should not be relied upon at less than 20 per cent. of the scale value. With recording meters, the limitation of 10:1 is relatively more serious, but less so than would appear on first consideration.

APPROPRIATION FOR WIRELESS.—For wireless telegraphy work in the United States Navy during the coming year the Bureau of Equipment will recommend an appropriation of nearly $300,000.

TROLLEYS IN ARGENTINA.—A movement is on foot to organize a company for the purpose of building an electric railway at Rosario, a city of about 122,000 inhabitants, in the Province of Santa Fé, Argentina.

THE TELEPHONE AND THE FARMER.—Governor Durbin, of Indiana, in his address at the St. Louis Exposition Indiana Day, said that the Indiana farmer of to-day, with a telephone at his elbow, an interurban line through his farm and mail delivered daily at his door, is nearer the Atlantic seacoast than he was to his county seat a few years ago.

CHEFOO WIRELESS STATION DISMANTLED.—United States Consul-General Fowler, at Chefoo, China, has telegraphed the State Department at Washington that the wireless telegraph station at that point has been dismantled. This is the station that the Japanese threatened to destroy unless it were discontinued, alleging that it was being used by the Russians as a means of communication with Port Arthur.

NEW OCEAN CABLE LINES IN THE ORIENT.—As already noted, a group of German and Dutch capitalists, bankers and merchants have formed a joint stock company for the purpose of constructing and operating a new ocean telegraph line whose cables are to connect the Island of Celebes (Dutch East Indies) with the Island of Yap, whence one cable is to reach Shanghai, the other the Island of Guam, where it communicates with the Pacific cable of the Commercial Cable Company. The working capital of this new line is $1,066,000; the estimated cost of the cable lines, $3,451,000. From the Governments of Holland and Germany the company is to receive a total annual subvention of $452,200. The official name of the new concern is the German-Netherlands Telegraph Company. Its central office is at Cologne.

EUROPEAN TESTING LABORATORIES.—Dr. C. H. Sharp at the recent Edison convention presented some notes on European testing laboratories. The paper treated briefly of the predominating features of such laboratories in England, France, Belgium and Germany. Comparing materials and methods in European laboratories and those with which we are familiar at home, it is noted that we have as yet no laboratory which can be compared with the Reichsanstalt in Charlottenburg, a suburb of Berlin. In none of the foreign laboratories is there an equipment for all the various kinds of photometric work which equals in completeness or in excellence that which the Electric Testing Laboratory (New York) has installed. The one most nearly approaching this is the equipment at Laboratoire Central (Paris), in which a great many of the most important photometric measurements of recent years have been carried out. The methods of performing tests in foreign laboratories are, in general, less expeditious than in this country, due primarily to the use here of Weston direct-reading instruments.

GAS POWER VERSUS ELECTRIC.—An interesting little discussion of gas engines in competition with electric motors was made before the recent Edison convention by Mr. F. M. Kimball. The paper brings out some of the more prominent arguments which may be availed of by a motor salesman meeting gas or gasoline engines in competition. In approaching a prospective customer, some of the arguments which should be pushed and fully elaborated are low cost of initial installation and cheapness of maintenance, certainty of adequate power supply for all demands, ability to locate the motor without encroaching on valuable floor space, freedom from fire risks, simplicity of construction, ability to start and stop quickly and without adjustment or manipulation of valves or levers; extreme steadiness of speed, thereby leading to increased production of more perfect goods; freedom from danger to employes, ability to adopt group or individual drive, as circumstances warrant, with consequent avoidance of losses in distributing units if required, and finally, reliability of service under practically all conditions.

HIGH-TENSION TRANSMISSION.—Mr. D. L. Huntington read a paper at the convention of Edison Illuminating Companies on some operating experiences in high-tension transmission. In order to locate rapidly any trouble on the transmission circuits (at Spokane, Wash.), the line is divided into test sections, connected by knife switches located on poles at the section points. These switches are opened and then closed in succession until the trouble is located in a definite section, when the patrolmen at each end work toward each other. Insulation should be provided with a heavy central section that will withstand a heavy blow without shattering and remain intact in the centre, even though all the petticoats are stripped off by pistol shots or otherwise. Considerable difficulty has been encountered in preventing the accumulation of sediment on the interior of cooling coils even when the water is apparently very clear. To remove the sediment, the water is shut off and compressed air is forced through the coils, which agitates the water and sediment, which is then drawn off as mud. Trouble on telephone lines due to leaks at the ordinary carbon lightning arresters has been overcome by the use of a specially designed spark gap. Inductive effects have been eliminated by proper transpositions.

ALTERNATING-CURRENT RECTIFIER.—The use of transformers for obtaining six-phase current from three-phase supply lines and means for mechanically rectifying the six-phase current are embodied in an invention of Mr. C. M. Green, for which a patent was issued August 30. The inventor uses three rectifiers driven synchronously with the alternations of the supply current. Each rectifying commutator is of the construction ordinarily used for rectifying currents in quarter-phase relation to each other, the quarter-phase currents for each being obtained from properly selected pairs of the secondary six-phase circuits. The three rectifiers are electrically connected in series and mechanically so arranged that the pulsations of e.m.f. due to one are partly compensated by the pulsations due to the others, the resultant wave of e.m.f. being practically uniform in value. The quarter-phase relation of the secondary e.m.f's may be obtained from combination of delta and star-connected, three-phase circuits, using six single-phase transformers, or there may be used three transformers each with three secondary coils interconnected so as to give three quarter-phase circuits in the secondary.

LETTERS TO THE EDITORS.

Lighting in St. Louis City.

To the Editors of Electrical World and Engineer:

SIRS:—In a paper I read before the National Electric Light Association at Boston in May, reference was made to the use of the 220-volt lamp in St. Louis. I made the statement that the installation at St. Louis in 1899 was made under the engineering advice of Mr. Bion J. Arnold. Mr. H. H. Humphrey, of St. Louis, advises me that the recommendations covering the adoption of the 220-volt lamp in the installation in question were made by Messrs. Bryan & Humphrey, in September, 1897, and that the system was installed under their direction as supervising engineers. In view of these facts, I would be pleased to have you publish this correction.

PROVIDENCE, R. I. WALTER I. BARNES.

Wireless and the Truth.

To the Editors of Electrical World and Engineer:

SIRS:—I note with interest in your issue of September 10 two communications with regard to the real truth underlying the various statements now made by competitors in the wireless field respecting or disrespecting each other. If I were a pessimist I should be inclined to believe the awful accusations thus aimed by the combatants, but I remember similar episodes in sacred history and profane, as well as in the course of electrical development. There are always instinctive likes and dislikes, implanted in us for the purpose of preventing the world being all one monotonous expanse of harmonious gray or blue or green; but generally speaking the antagonisms born of political, social and technical competition permit of a later reconciliation. Of course I do not include the Daughters of the Revolution or the Sons of Gunners in these reflections.

The course of events in electrical development therefore should teach us that the present interchange of unstudied compliments between the wireless champions and their pugilistic backers is but a

passing sign of the times, all to be forgotten when the Institute celebrates, years hence, the twenty-fifth anniversary of the assimilation, absorption and successful establishment on a distinctly non-personal basis of the wireless art. I have been rejoiced to observe the frank impartiality with which you have opened your columns to all oncomers in this wireless but certainly not wordless controversy, and I trust you will continue to add to the gaiety of dull Sunday afternoons by allowing De Forest to prove how much greater he is than Marconi, Fessenden to demonstrate that he "contains" them both, and Collins to dilate on the momentous importance of their subtle differentiations. As President Roosevelt remarked, peace is all very well, but no nation or art is really happy that cannot sit around the cheerful hearth of a red-hot controversy. Was it not Silvanus Thompson who said that when there was no longer an electrical row going on, electricity would be dead—and that he himself might just as well be? What would Edward Weston do if each day were not gladdened by the prospect of a new fight?

NEW YORK CITY. BALDWIN STEVENS.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Distribution of Magnetic Induction in Multipolar Armatures.—THORNTON.—An illustrated British Association paper. The most suitable radial depth for the armature core of direct or alternating-current machines can be found by a consideration of the manner in which the induction is distributed from the periphery inward at a section midway between the poles. This depends upon the pole spacing, the length of the air-gap, the flux density within it and upon the radial depth of the core. The author has studied the effect of each of these upon the flux density in the core. For this purpose he reproduced the magnetic circuit of a multipolar machine in miniature. Each of the poles could be adjusted by means of slots in the cast-iron yoke, and the length of the air-gap varied by thin sheet-iron washers inserted between the pole and the yoke. The results of the tests are given in a series of diagrams. The depth at which the maximum flux density is found is independent of the intensity of magnetization except when the air-gap is small and the density great, in which case the maximum is slightly deeper at the higher values. Again, the position of the maximum is independent of the length of the air-gap, depending only upon the pole pitch. The wider the pole pitch, the deeper is the maximum and the greater the flux density toward the center. The ratio of the maximum density to that in the gap is greatest when the pole pitch is small. The author considers that there is a reasonable scientific basis for the designer's rule that the ratio of radius to radial depth should be half the number of poles. It is suitable for first approximation and working values should be made somewhat less.—Lond. *Elec.*, August 26.

REFERENCE.

Direct-Current, Self-Exciting Dynamos.—SARRAT.—A mathematical article, giving with the aid of diagrams a theory of self-exciting, direct-current dynamos. After a general discussion of the subject he shows how to determine the voltage at the terminals, how to treat the case of constant voltage operation, and how to predetermine the characteristic curves. The article is concluded by a special study of the shunt-wound dynamo.—*L'Eclairage Elec.*, August 20.

Compensated Alternating-Current Commutator Motor.—PICHELMAYER, ZIEHL, BECKMANN, BEYER.—Various communications with reference to a letter of Benischke concerning the theory of the phenomena during commutation in a compensated alternating-current commutator motor.—*Elek. Zeit.*, July 28.

LIGHTS AND LIGHTING.

Energy Spectrum of Mercury Lamp.—LADENBURG.—An account of a determination of the energy spectrum of a quartz mercury arc lamp. The spectrum shows two series of well-marked lines, one of them corresponding to the wave lengths 253, 311, 363, 433 and 546, and the other to 297, 404 and 576. These series both show a steady increase of intensity in the order mentioned and the author suspects some underlying regularity, although he cannot establish a connection with Kayser and Runge's formulas.—*Phys. Zeit.*, August 15; abstracted in Lond. *Elec.*, August 26.

REFERENCES.

Secondary Standard of Light.—See the abstract of Fleming's paper on the use of large bulb incandescent lamps for this purpose under "Units, Measurements and Instruments."

Harcourt Pentane Lamp.—See the abstract of Paterson's paper under "Units, Measurements and Instruments."

POWER.

Electric Power in Coal Mines.—An illustrated description of the electric equipment of the Ehrenfeld Colliery of the Pennsylvania Coal & Coke Company. The power house contains two steam-driven, double-current, 150-kw generators and one steam-driven, 6,000-volt, three-phase, 300-kw generator. The double-current generators give a current of 600 amp. at 250 volts on the direct-current side or three-phase currents of 575 amp. at 169 volts and 25 cycles on the alternating-current side. From the alternators high-tension currents are transmitted to the sub-station in the mine. Current is used for electric locomotives, hoisting, driving ventilators, pumps, etc.—*Eng. and Min. Jour.*, August 18.

Power in Bulk.—An abstract of a British Association paper by Merz and McLellan on "The Use of Electricity on the North Eastern Railway and upon Tyneside." The great development of the use of electrical energy on Tyneside for general purposes enabled the Newcastle Electric Supply Company to undertake delivery to the railway company at a much lower rate than that at which the company itself could have generated. Apart from the railway, the factories of the district, employing some 40,000 men, depend for their power mainly on one station. In the discussion it was suggested to level up the load curve by using energy at times of light load for electrochemical purposes; in a certain case the cost was thus reduced to 0.4 cent per kilowatt-hour.—Lond. *Elec.*, August 26.

REFERENCE.

Electricity in Mines.—A note stating that mines in the Joplin and Webb City districts, Missouri, are rapidly equipping their plants to run by electricity.—*Iron Age*, August 25.

TRACTION.

Insulation Resistance of Electric Tramway Systems.—PEDRIALI.—A paper presented at the Vienna meeting of the International Street Railway and Interurban Railway Association. The author describes various methods for testing the insulation resistance. Some companies use a voltmeter which is inserted between the positive pole of the dynamo and that part of the line the insulation of which from earth is to be measured. If the voltage between the positive pole of the dynamo and earth is V, and the reading of the voltmeter is V', the insulation resistance is $R = (V - V')\ r/V'$, where r is the resistance of the voltmeter. This method gives exact results only if the resistance is of about the order of magnitude of the resistance of the voltmeter; but it is not to be recommended for the determination of faults in insulated cables. An effective and quick method for determining the existence of faults (without measuring the same) consists in observing the readings of the ammeter of the first dynamo started in the morning; if, when all cars are insulated from the trolley wires, the needle of the ammeter is deviated, it must be concluded that the network contains a fault; this may then be localized by opening the different line switches. On conduit and surface contact systems the insulation should be regularly tested every day. "On lines both poles of which are insulated from earth, it is necessary to take into account the electrolytic phenomena which tend to transport moisture from the positive to the negative pole;

the greatest attention should be paid to this point." The author recommends to lay out for each network a map on which those points are marked where the voltage difference between rails and water or gas pipes is largest, and to provide test pipes at these points which are tested in regular intervals. Except when welded rail joints are used, it is necessary to test the resistance of the joints at regular intervals. Tests of insulation of the trolley wire are made by some companies in a rough way to find whether the insulators have a fault or not. In this case the hanger, *X*, in Fig. 1, is tested to find whether

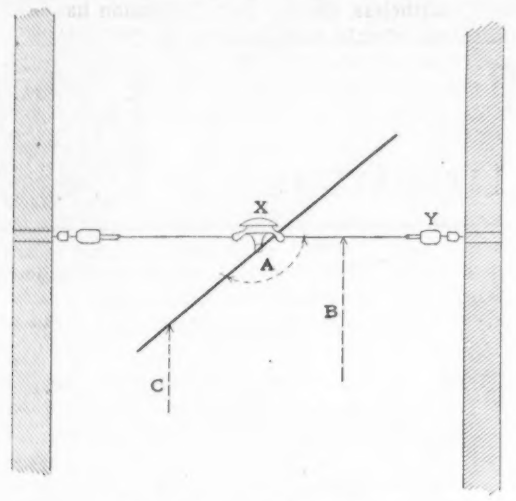


FIG. 1.—INSULATION TESTS.

the current passes over to the span wire. In most cases there is used a voltmeter which is connected with one pole to the span wire and with the other pole to earth; afterward the strain insulator, *Y*, is tested by connecting the span wire between *X* and *Y* with the trolley wire and connecting the pole to the rails, a voltmeter being inserted. This method gives only approximate results. The author states that the following "method of three readings" has often given good results. If *A*, *B*, *C* are the readings of the voltmeters, as indicated in Fig. 1, *R* the resistance of the voltmeter, *X* the resistance of the hanger, *Y* the resistance of the pull-off, then $X = (C\ A\ B)\ R/B$ and $Y = (C\ A\ B)\ R/A$. For finding faults in conduits, two groups of test lamps are provided on the switchboard which are

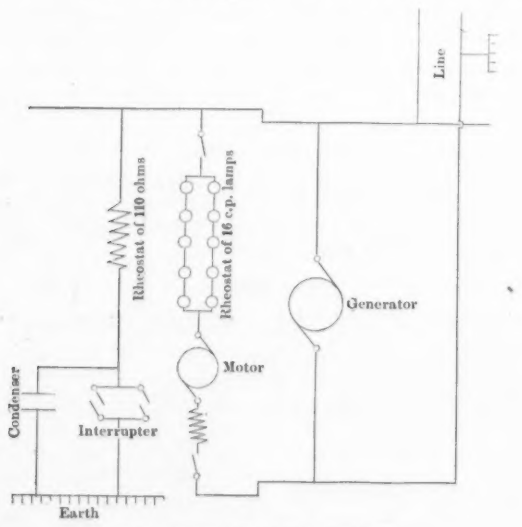


FIG. 2.—INSULATION TESTS.

inserted between the two poles of the conduit, while the center connection between the two lamp groups is connected to earth. If one of the two poles is earthed the lamp group connected to the other pole lights up. It often happens that a foreign body makes contact between the conductor and earth. Such a contact may sometimes be removed by sending through the line a strong current, adjustable by means of a rheostat. If this means is not sufficient, the fault must be localized. The author considers the following method of Gérard to be very practical. In parallel with the dynamo, a motor, *M*, of small capacity is provided which is geared to an interrupter; the other arrangements will be seen from Fig. 2. As soon as it is found that a fault exists, the apparatus is connected to the negative pole and the motor is started. A regularly interrupted current of about 5 amp. now passes through the fault, the frequency of the interruptions being 70 to 80 per minute. Now, a coil of 250 windings of 0.6-mm. wire, which is closed through a telephone, is passed along the conduit. The telephone then gives a regular steady noise until the fault is reached, when the noise disappears. The second part of the report deals with the maintenance of the trolley wire. The author recommends that tests be made at regular intervals and the results be recorded. The span wire should be as elastic as possible. The tension of the trolley wire at 0° C. should be between 450 and 550 kg. (for wires of 52.5 sq. mm. cross-section). Several other mechanical details of construction are dealt with.—*From an advance copy of the paper.*

Brakes.—SCHOLTES.—A report presented at the Vienna meeting of the International Street Railway and Interurban Railway Association on brakes for electric street railways, based on information received from 54 companies and on a former report of Poetz which covered the practice of 20 companies. Scholtes distinguishes the following three groups: In the first group hand brakes, operated by the motorman, are used and only in special cases are short-circuit brakes applied; this method is used in 63 per cent. of all companies which replied to the inquiries. The author calls attention to the hand brake used by the Leipzig street railway. In the same a sufficient braking effect is obtained by a friction device between brake gear and brake crank without any exertion of the motorman, since the momentum of inertia of the car is utilized for pressing the brake shoes against the wheels. This brake is stated to have proved very satisfactory. Besides the hand brake, most of the companies in this group use the electric short-circuit brake as an emergency brake. The second group comprises those companies which use in general electric brakes, together with hand brakes. This is done by 22 per cent. of the companies. In this case the trailers are also generally braked electrically. The author seems to be rather favorably inclined toward the electric brake. The motors should be chosen of sufficient capacity to prevent undue heating. On grades the cars must be stopped by means of the hand brake. The third group comprises air brakes and is subdivided by the author into two classes. One class comprises four companies which have air brakes on all motor cars, the other six companies which use air brakes on only a portion of their cars, only the heavy trains and cars being provided with the same. The author has made careful measurements of the power required for operating the air pump; the energy consumption with electric braking and without the air brakes was 429 watt-hours per km., with the air brakes 456 watt-hours per km., so that the difference of 27 watt-hours = 6.3 per cent. was the energy consumed by the pump. The statements of the different companies as to cost of operation and maintenance are scarce and vary greatly, the average values being as follows: Hand brakes, 0.06 cent per car-km.; electric brake, 0.02 cent per car-km.; air brake, 0.08 cent per car-km.; so that the air brake is the most expensive one. The general conclusions of the author are that the load conditions are to be taken into account. The brakes should not cause any jerking. There should always be two independent brakes. The main brake must not tire the motorman out. If the hand brake is insufficient as main brake on account of too great a weight or too great a number of trailers, or too difficult conditions of the track, a mechanical type of brake should be used and the electric brake should be introduced. Under special conditions (for instance, if the motors have not a sufficient capacity, or if the controllers and rheostats have not enough steps) air brakes may be used to advantage. For heavy loads, high speeds and with more than two trailers, air brakes should always be used.—*From an advance copy of the paper.*

Saving of Electrical Energy in Street Railway Service.—KLITZING.—A paper read before the Vienna convention of the International Street Railway and Interurban Railway Association. He gives a summary of the replies sent by 47 companies to an inquiry as to methods employed for reducing the consumption of electrical energy. This consumption varies in the different systems between 350 and 962 watt-hours per car-km. and between 50 and 105 watt-hours per ton-km. Means suggested for reducing the energy consumption are schools for motormen, introduction of the three-wire system, payment of a premium to economical motormen and control of the energy consumption by meters installed on the cars.—*From advance sheets of the paper.*

WIRES, WIRING AND CONDUITS.

Standards for Electric Wires and Cables.—A note stating that the British Engineering Standards Committee has issued its standards

for copper conductors and thicknesses of dielectric. The standards for copper conductors are practically the same as those adopted by the British Cable Makers' Association, the chief difference being that the increase in resistance and weight due to the loss in lay on stranded cables is taken as 2 per cent. in all wires except the center wire, instead of 1.01226 per cent., as adopted by the association. The standard limits of working pressures chosen are 660, 2,200, 2,300, 6,600 and 11,000 volts, instead of 500, 2,000, 3,000, 6,000 and 10,000 given in the association's tables; but the same thicknesses of dielectric and lead are adopted, the only alteration made being in the specified tests for working pressure. For working pressures up to 360 volts the test at the works for paper cables is to be 2,500 volts for half an hour; when laid and jointed the pressure test is to be 1,000 volts in both cases. The tests for high-pressure and extra high-pressure cables have also been altered to a slight extent, half an hour in most cases being the time adopted during which the voltage is applied, instead of 15 minutes and one hour, as in the British Cable Makers' Association's rules. Standards for rubber-insulated, lead-covered cables have also been set up, the dielectric thickness being slightly less in the case of the smaller cables, but greater in the case of the larger cables, than with paper cable with corresponding size of conductor; and the lead in some cases is slightly thicker. There is also a table for rubber-insulated, lead-covered cables for internal wiring, the dielectric thickness in this case corresponding to those in the wiring rules of the British Institution of Electrical Engineers.—Lond. *Elec.*, August 26.

Eddy Current Losses in Cables.—FIELD.—A note on a British Association paper on eddy current losses in the lead sheaths of three-phase cables. He announces the law that these losses go up as the sixth power of the diameter. This large rate of increase soon imposes a limit on the size of cable practicable. The law requires some modification if the skin effect is taken into account. Again, in three-core cables, and with cores of circular cross-section, proper construction can reduce the external field so as to render its effects small, but then there is considerable eddy current loss along the center of the core. Thus, in any case, an early limit is set upon the size of cables.—Lond. *Elec.*, August 26.

REFERENCE.

Alloy Wires.—See the abstract of the paper of Wilson, under "Electrochemistry."

ELECTRO-PHYSICS AND MAGNETISM.

Propagation of Magnetism.—PERKINS.—An account of an experimental investigation of the velocity of the propagation of magnetism. The effect of self-induction in a circuit causing a retardation in the establishment of a magnetic flux is well known; but an allied effect, caused not by the inductance between coil and magnetic circuit, but in the magnetic circuit itself, thus causing a very perceptible interval of time between the appearance of the magnetism at two points, has not been so thoroughly studied, although it must be present in all alternating-current machinery to a certain degree. This retardation is thus due to the eddy currents in the core of the magnet in question and is a complicated function of the various physical properties of the core, the frequency and magnitude of the impressed e.m.f. The main conclusions reached by the author are that the velocity of magnetism in metallic paths, and especially those of high permeability, is small compared to that in non-conducting bodies. This effect is due to eddy currents, and therefore variable, diminishing as the flux diminishes along the bar. It depends on the physical properties of the bar, such as ohmic resistance and permeability, as well as the magnetic density at the point in question. This retardation is great enough to cause a very perceptible lag where the density is high and the lamination poor; great enough, indeed, it would seem, to call for recognition in the design of many forms of electromagnetic machinery.—*Amer. Jour. of Science,* September.

ELECTRO-CHEMISTRY AND BATTERIES.

Electrolytic Production of Sodium.—CARRIER.—An illustrated account of experiments in which he investigated the process of Becker, which differs from that of Castner, since Becker uses as electrolyte a mixture of sodium hydroxide with sodium carbonate or other sodium salt, without a screen diaphragm. The author concludes from his experiments that the Becker process, as described by the inventor, cannot be carried out and that only the sodium hydroxide is decomposed, so that it is nothing more or less than an inferior Castner process.—*Electrochem. Ind.*, September.

Aluminum Alloys.—E. WILSON.—A British Association paper on the effect of the atmosphere of London on the conductivity of certain light aluminum alloys. The tests began in 1901. During the first two years' exposure of wire, the series of copper-aluminum alloys diminished in conductivity to a greater extent the greater the percentage of copper. This process progressed still further later on, but the yearly variation is not now so great as during the first year. Nevertheless, the previous conclusion has been confirmed that copper alone should not be used in fairly large quantities when alloyed with aluminum to be exposed to the London atmosphere. Of the nickel-copper-iron-aluminum alloys, that which is richer in nickel has changed comparatively little, while that richer in iron shows a gradually increased rate of deterioration; both of these alloys have a comparatively high tensile strength. The manganese-copper-aluminum alloys have suffered comparatively small diminution in conductivity; the same is the case for the iron-copper-aluminum alloy, and the breaking load of the latter is considerably higher than that of good commercial aluminum. Exact figures are given in form of a table.—Lond. *Elec.*, August 26.

REFERENCES.

Ferro-Alloys.—SCHOLL.—The first part of an article on the manufacture of ferro-alloys in the electric furnace. Various types of furnaces used for this purpose on an industrial scale are described.—*Electrochem. Ind.*, September.

Rotating Cathode.—MEDWAY.—An account of experiments in which he found that for electro-analytical purposes a rotating platinum crucible may be replaced by a silver crucible. Rotating discs may also be employed, but are inferior to the rotating crucible.—*Amer. Jour. of Science,* September.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Large Bulb Incandescent Lamps as Secondary Standards of Light.—FLEMING.—A British Association paper on the results obtained by the author in the use of large bulb carbon filament electric incandescent lamps as secondary standards of light. Concerning their construction, the following precautions are to be taken: The filament should preferably be in the form of a single loop or horseshoe, and should be mounted in the large cylindrical bulb with great care, so that the plane of the loop lies in the axial line of the lamp, filaments being selected with the two sides of the loop in the same plane and not distorted. In some cases it is desirable to anchor the filament by a loose loop of platinum wire, sealed into the bulb, but such loop of wire should not touch the filament or constrain it when the lamp is at rest or in use. Owing to the fact that the 16-cp, 100-volt filament is about 9 in. in length, it is desirable, if possible, to employ a 10-cp, 60-volt large bulb photometric lamp as a standard. The 16-cp, 100-volt lamp of this type is much used and the 16-cp, 200-volt lamp has been made, but is not recommended. It is not desirable to employ two filaments in parallel, as they may then be at different temperatures; but they can be placed in series, one loop within the other, and both lying in the same plane. In setting the lamp in the photometer, great care must be exercised to adjust the lamp axis perfectly vertical, and a plumb line should be employed on the scale of the photometer bench. Several precautions which must be taken in the use of the lamp are also described. The great objection to all flame standards is the degree to which their candle-power is affected by moisture in the air and changes in barometric pressure. There is practically no change in the candle-power of the large bulb incandescent lamps with change of temperature of the surrounding atmosphere. The author finally gives some rules for equipping an electrical laboratory with the means of preserving a standard of light. He has arranged a simple apparatus consisting of a large bulb lamp, a rheostat and an ammeter, the range of which comprises merely the ordinary lamp currents. The ammeter is, however, not graduated to read amperes, but graduated to read candle-power, so that if the rheostat is adjusted to make the ammeter needle point to any part of the scale, that scale reading would at once, without further calculation, give the candle-power of the lamp in the normal direction. Although this apparatus is not accurate enough for laboratory purposes, yet for workshop or generating station purposes it is a convenient arrangement for obtaining a fairly accurate standard of light without the complications involved in the use of the potentiometer.—Lond. *Elec.*, August 26.

Motors in a Bread Bakery.

BY H. W. HEINZ.

It may be interesting for the readers of this paper to know something about the experience I have had in direct motor drive. The plant of which I at present have charge—the Ward-Mackey Company's "Mother's Bread" plant at Pittsburg—is driven by individual

FIG. 1.—GENERAL ARRANGEMENT OF MACHINERY IN MIXING ROOM.

motors. We have in the mixing room six machines, each of which handles 1,400 pounds of dough per mix. This dough requires a 25 minute run and each machine is driven by a 50-hp motor. We connected this plant up with rawhide to steel drive. This mixing dough is a peculiar body to handle in the machine, owing to its unequal weight from centers at times, and the trouble we at once experienced was the hammering out of our motor bearings on account of this great weight, the machine revolving at 60 r.p.m.

Finding it necessary to rebabbit these journals so frequently, we were obliged to look around for something more flexible in our drive. We ordered a 4-in. Morse silent chain, as an experiment, having 22-in. centers to driven wheel. This first chain has been so satisfactory that we have since installed three others. We find absolutely no repairs necessary to bearings and everything running in first-class condition. After running three months we had a pin break in our first chain, and we placed a new one in less than five minutes. Before

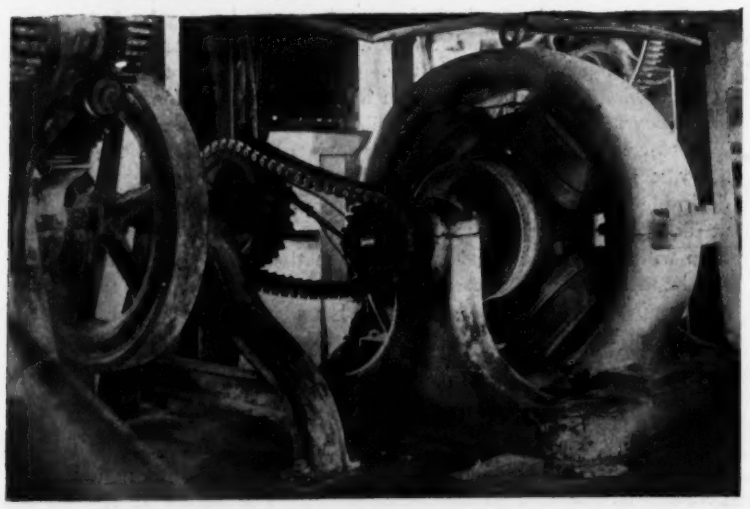


FIG. 2.—50-HP CHAIN DRIVE.

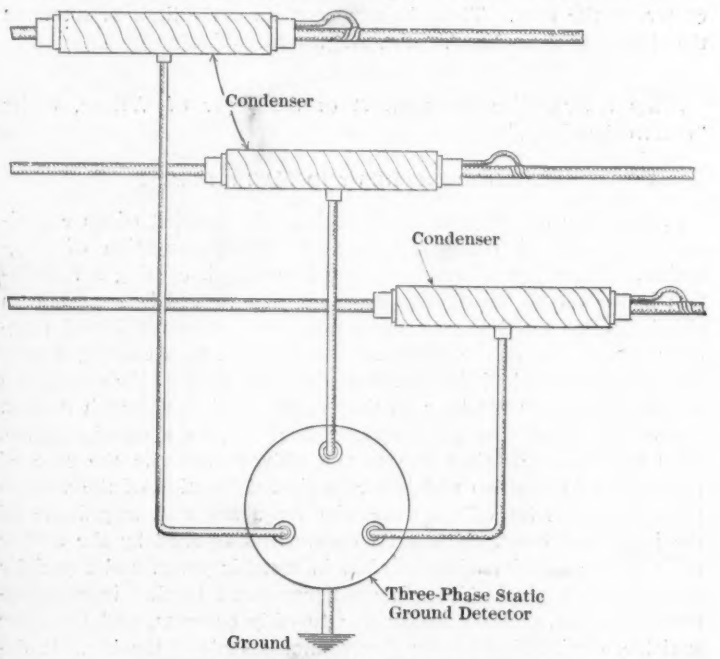
resorting to Morse chain drive, our motors required 280 amperes to operate. With the chains, the motors show but 135 amp. by meter—a saving of over 50 per cent. These chains require very little lubrication, and are noiseless. We have recently installed several Morse chains in our branch factories.

We consider our plant in general the most up-to-date bread baking establishment in the country. The flour comes in from the railroad siding, is unloaded on a slide into the cellar and stored. From there it is conveyed to our storage bins on the top floor by means of electric motor, from which place it is transferred to individual automatic scales and dropped directly into the mixer. There it is mixed and left ready for the bread men on the floor below, where the baking is done. After coming from the oven the product goes down to the first floor and is shipped. Our electrical plant at the bread bakery consists of Harrisburg standard engines and Westinghouse generators of 200 kw capacity. The entire building is wired on the conduit system with individual control at switchboard in power house and at motors. Our cracker bakery, which is a block away from the present new "Mother's Bread" bakery, also has a similar equipment.

A New Three-Phase Static Ground Detector.

Static ground detectors, designed to enable the central station operator to determine at a glance whether a ground exists on a single-phase circuit, have become well recognized as a necessary part of every first-class installation. These single-phase instruments are entirely satisfactory on two-phase circuits as well. For three-phase circuits, however, although the practice has been to use two or three single-phase instruments either in separate cases or combined in the same case, this arrangement is open to the objection that the indications of the pointer are not direct, some time being required for a person not familiar with the instruments to determine which line is grounded. It is only recently that a design has been produced which enables a ground in a three-phase circuit to be indicated directly by the use of one instrument. The accompanying illustration shows the three-phase static ground detector made by the Westinghouse Electric & Manufacturing Company and supplied for circuits of from 1,000 to 15,000 volts potential.

Its method of operation is indicated by the diagram of connections. It will be seen that each of the three fixed vanes is connected to a line of the three-phase circuit. The central movable vane is electrically connected to the case, which is grounded. When there is no ground upon the circuit the attraction or pull upon the central vane from each of the fixed vanes is balanced and it does not deflect from a central position. Should one of the lines become grounded, and the potential of that line become the same as that of the movable vane, there will be no pull in that direction, and the movable vane will be deflected away from the grounded line. The instrument



CONNECTIONS OF STATIC GROUND DETECTOR.

is reliable in its indications and has no complications in its mechanism or construction.

In the diagram, the three leads to the ground detector are shown with a condenser inserted between each line and the instrument. This obviates the necessity of carrying high-tension wires to the front of the switchboard. Each of the condensers consists of a brass tube covered with insulating material, and placed within a copper sheath, the line being connected to the inner tube and the lead to the copper sheath.

This ground detector is ornamental in appearance. In shape and size it corresponds with the other Westinghouse round pattern switchboard instruments. The interior of the case is given a dull black finish against which the aluminum vanes stand in distinct relief, while the angles of deflection marked upon the glass face form a pleasing geometrical design. In every way it is a high-grade instrument.

The Westinghouse Turbine Exhibit at St. Louis.

Probably the most interesting piece of power-producing machinery at the Exposition is the steam turbine. The Westinghouse exhibit is particularly interesting in that visitors thus have the opportunity of studying a working plant complete in every detail of equipment with its auxiliaries is standard in every respect and representative of the most modern practice in present power station work, a brief description of the equipment is believed to be of interest. The principal data are given in the following table:

Turbine.—Type, Westinghouse- Parsons multiple expansion parallel flow, No. 53; capacity of turbine, nominal, 600 hp; capacity of tur-

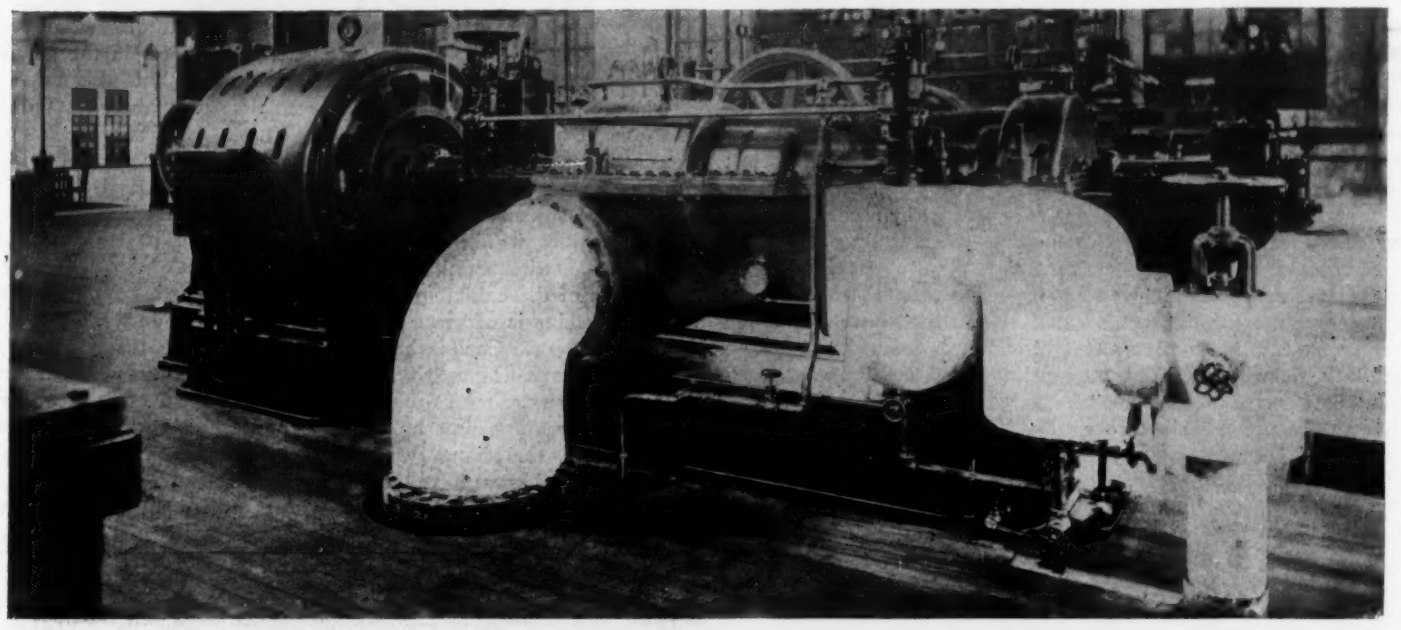


FIG. 1.—WESTINGHOUSE-PARSONS STEAM TURBINE, PHOTOGRAPHED AT NIGHT BY AID OF COOPER-HEWITT MERCURY VAPOR LAMPS.

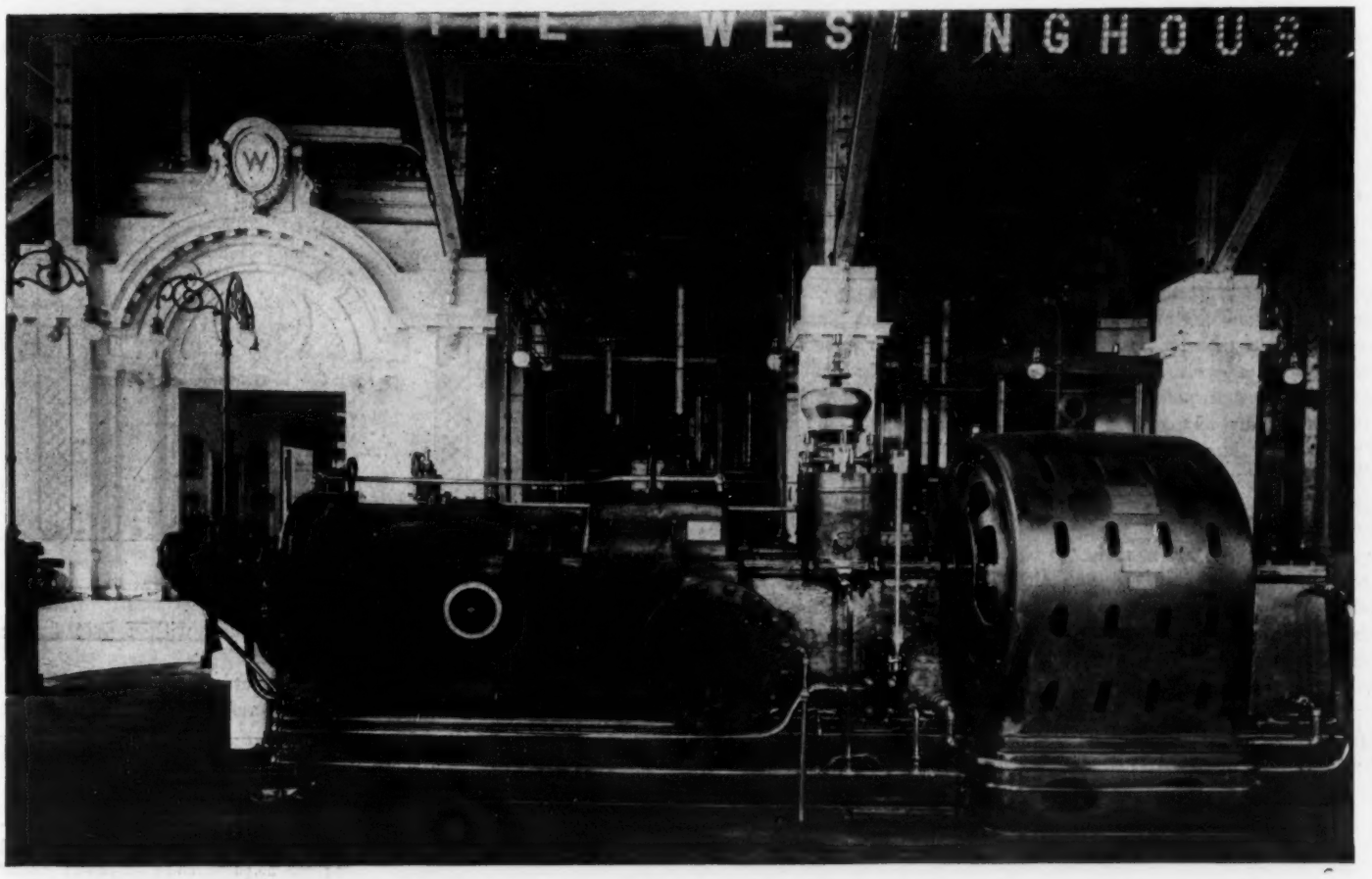


FIG. 2.—600-HP WESTINGHOUSE-PARSONS TURBINE DRIVING 400-KW WESTINGHOUSE TURBO-GENERATOR, MACHINERY HALL.

and subject to the same conditions of service that would obtain generally in actual practie. The plant is not running idle. The turbine was started on June 20, at 9.40 a. m., and has since been in continuous operation with the exception of a four-hour shut-down due to the breaking of the steam supply main, during this time furnishing 60-cycle, 440-volt current for lighting and for operating various motor and railway exhibits of the Westinghouse companies in the Palaces of Machinery, Transportation and Electricity. As the turbine equipbine, rated, 400 kw; overload capacity, guaranteed, 50 per cent.; overload capacity, actual, 75 to 100 per cent.; length of unit, 18 ft. 6 in.; height of unit, 4 ft. 6 in.; width of unit, 7 ft. 6 in.; net floor space required, 138.6 sq. ft.; floor space, including passageways and auxiliaries in basement, 292 sq. ft.; net floor space per e. h. p., .258 sq ft.; gross floor space per e. h. p., .545 sq. ft.; steam pressure, average, 150 lbs.; vacuum, 27 to 28 in.; speed, 3,600 r.p.m.

Generator.—Type, revolving field turbo, No. 235,686; rated capacity,

400 kw; voltage, 440, 3-phase; number of poles, 2; frequency, 60 cycles per second, 7,200 alternations per minute; winding, statorion armature, bar rotor on field, strap on edge; exciter capacity, 25 kw driven by a Type C induction motor from A. C. bus.

Condenser—Type, Worthington surface, with air cooler; cooling surface, 1,500 sq. ft.; cooling surface per e.h.p., 2.8 sq. ft.

Auxiliaries.—Dry air pump, single stage, horizontal, rotative type, dimensions, 6 in. by 10 in. by 10 in.; hot well pump, Worthington centrifugal volute type, diameter of discharge 1¼ in.; hot well pump motor, Westinghouse, 2-phase, Type C, induction speed, 1,700 r.p.m.; voltage, 400.

Piping.—Steam, to turbine, 5 in.; exhaust, from turbine, 20 in.; atmospheric exhaust, 12 in.; condenser suction and discharge, 8 in.; hot well discharge, 2½ in.; air discharge, 4 in.; air pump, steam, 1 in.; exhaust, 1½ in.; air suction and discharge, 2½ in.

The entire turbine unit on exhibit is supported by a concrete steel floor of standard construction comprising 12-in., 40-lb. "I" beams spaced 20½ in. under the generator and 28½ in. under the turbine. Concrete arches sprung in between these beams complete the supporting structure for the turbine unit. Beneath this steel structure is the pit, 10 ft. 3 in. in width, 28½ ft. in length and 9½ ft. in depth beneath the floor beams. This pit contains the entire auxiliary equipment, but has been constructed of larger dimensions than would ordinarily be necessary in order to provide extra convenience for visitors.

On account of the treacherous nature of the subsoil it was found necessary to construct foundation walls and floors of concrete, the former serving not only as supports for the turbine unit, but also as retaining walls. The equipment as a whole thus indicates an advantage of the turbine which is not possessed by any other form of prime mover, namely, that on account of the small foundations necessary the entire auxiliary equipment may be located directly beneath the turbine. This arrangement obviously favors the attainment of the highest vacua by eliminating long lines of exhaust piping with their many turns encountered in a plant employing the central condensing system. With closely spaced units, either the central or remotely located condenser becomes a necessity; and in the experience of at least one large power plant, namely, the Manhattan Railway Company of New York, it has been found profitable to entirely eliminate exhaust piping by locating condensers of the barometric type directly at the main engine exhaust openings. It is apparent that the turbine makes possible this identical arrangement, with the additional advantage that a surface condenser may be used and the condensed steam, which is pure and free from oil, thus returned to the boilers.

The steam supply of the turbine is drawn from a pipe trench some 100 feet distant and fully 600 feet from the boiler plant, which is located in the Steam and Fuels Building. As no superheaters are employed in the Exposition service plant which is served by these boilers, only saturated steam is available at the turbine, which is rendered as dry as possible by a vertical separator in the supply line. The exhaust leaves the turbine through a short radius 90 degree elbow and descends directly into the condenser beneath, a 20-in Chapman valve being provided for isolating the condenser when necessary. In case of loss of vacuum or repairs being conducted upon the condenser, a 12-in. atmospheric line leads the steam up through the roof of the building, this line being controlled by a Blake relief valve which automatically opens as soon as a slight pressure above atmosphere is reached in the exhaust line.

An important point in the turbine equipment is the provision of a fluted copper expansion joint in the exhaust riser from the condenser to the turbine. The section is 14½ inches in length and is sufficiently flexible to absorb small expansions and contractions due to temperature changes or misalignment, thus relieving the turbine casing of the stress which would otherwise be put upon it.

The condenser is mounted upon two pipe struts at one end and a small brick pier at the other. Plain tubes are used throughout with packing glands at each end, thus allowing the removal of condenser tubes from either end. Incoming cold water circulates along the lower half of the condenser and emerges from the upper half. The condensed steam gravitates into a hot well 22 inches in diameter and flows directly to the motor-driven centrifugal pump which returns it to the boilers as fast as it gathers in the hot well. A check valve in the return line prevents flooding of the condenser should the hot well pump for any reason get out of service.

In high vacuum work it has been found desirable to remove from the condenser whatever air is carried over from any source either from leaks in the piping or through the boiler feed-water. This is accomplished by a rotative "dry" air pump which is driven by high pressure steam and exhausts into the condenser. Before reaching the pump the moisture is condensed and removed by a tubular air cooler located directly in the cold water inlet to the condenser. This condensed vapor drains back into the hot well and is returned to the boilers.

In arranging for the condenser circulating water for this plant the surplus capacity of the main Exposition surface plant has been made use of. Under normal conditions the large turbine circulating pumps supplying water to the barometric condensers in the service plant are called upon to furnish the additional supply to this outfit.

The unit is controlled by a very complete switchboard standing upon a gallery at the side of the exhibit. As a certain amount of D. C. power is required upon the grounds in the various Westinghouse exhibits for motor-driven tool demonstrations and the like a part of the power delivered by the turbine is converted by a 200-kw rotary standing within the exhibit enclosure, which is also controlled through the switchboard above mentioned.

Outside of the exhibit proper, the steam generating plant supplying the turbine is of great interest and may be made the subject of profitable study. Coal is handled automatically to the boilers, delivered through chutes to the hoppers of the Roney mechanical stokers, which are used to fire the entire equipment of service plant boilers aggregating 6,400 hp, all of Babcock & Wilcox construction. A feature in the piping system is that no supports were available from the roof trusses and consequently the entire system had to be supported from the boilers themselves or from the floor. Two complete mechanical draft equipments, each with fan in duplicate, provide draft for the entire boiler plant.

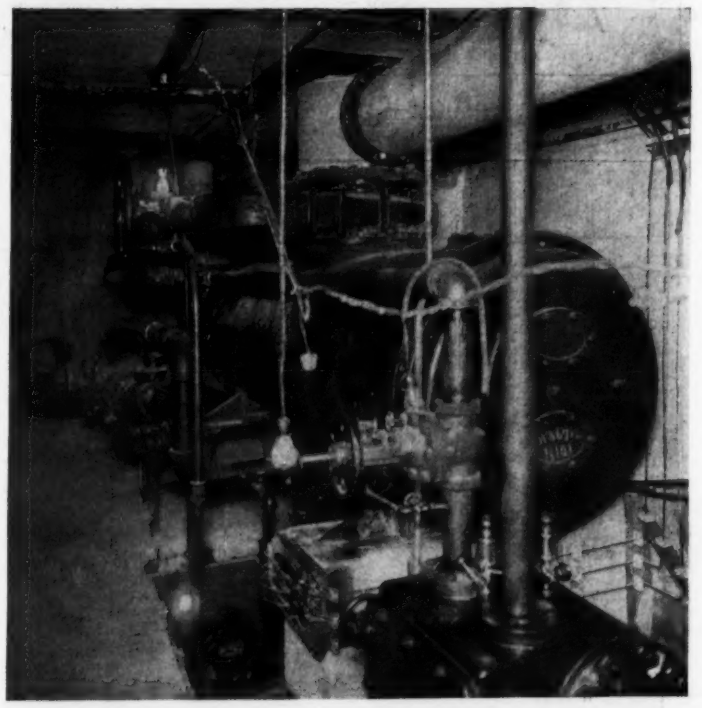


FIG. 3.—CONDENSING APPARATUS, TURBINE PIT, MACHINERY HALL.

A decided novelty is the circulating water and cooling tower plant serving, as before stated, the turbine and main service plant condensers. The water is handled entirely by Worthington turbine pumps driven by vertical Westinghouse compound engines with variable speed control and motor-operated valves. Four cooling towers of the fan draft type are in operation, especially designed by Westinghouse, Church, Kerr & Co., engineers and constructors of the entire service plant. An efficiency test is given above.

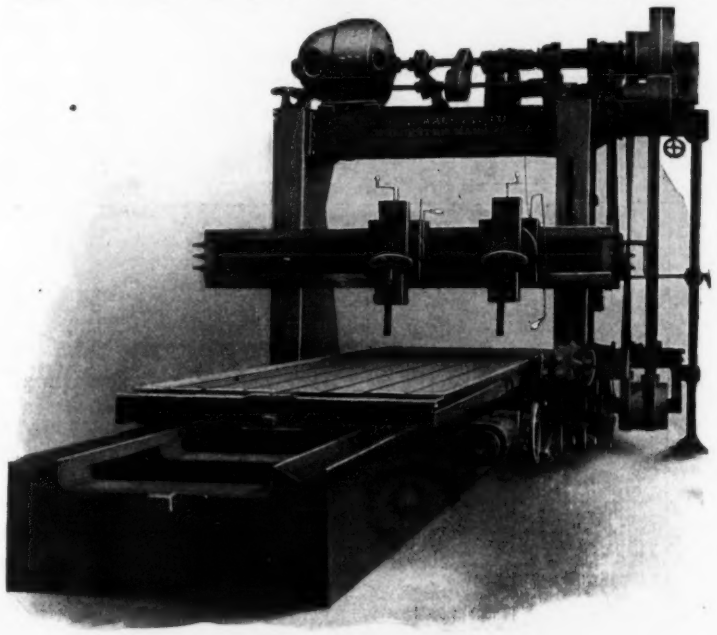
EFFICIENCY TEST OF 400-KW STEAM TURBINE ON EXHIBIT AT THE LOUISIANA PURCHASE EXPOSITION.

	Saturated Steam.	Turbine No. 53.			
Load .....Kw	418	300.1	193.5	99.4	.....
Load .....E.H.P.	561	403	259.5	133.2	.....
Steam pressure (throttle) Lbs.	149.2	148.5	149.3	150	150.9
Vacuum ...(Ref. to 30″ bar)	26.93	26.98	26.98	26.93	27.03
Superheat .....Deg. F.	6.7	8.8	4.5	5.6	.....
Quality	1.0038	1.005	1.0025	1.0031	.988
Speed .....r.p.m.	3553	3573	3586	3599	3516
Total water per hr. .....Lbs.	8412	6477	4768	3155	1214.5
Steam per H.P. per hr. .Lbs.	15	16.08	17.82	23.65	.....

Ingenious Motor Application to a Planer.

As is well known, large planers of the shifting belt type are generally run at comparatively low table speeds, for if high speeds be attempted numerous belt troubles are experienced, and in the case of a motor-driven planer the overload on the motor at the instant of table reversal from the forward to the return stroke becomes severe unless an excessively large motor be used. The accompanying cut shows a view of a heavy 96-inch planer, recently installed by the Crocker-Wheeler Co. at its works at Ampere, N. J., in which these objectionable features have been minimized.

This planer was built by the L. W. Pond Machine & Foundry Company, of Worcester, Mass., and has a 24-foot table and three heads. The motor, a 35-hp compound wound, is mounted on top of the housing. It is coupled to the shaft driving the fly-wheel pulley, and the diameters of the pulleys and gearing under the table are proportioned to give a return table speed of 70 feet a minute with the motor running at its maximum speed. The upper pulley for the forward-motion belt is mounted on a sleeve concentric with the above mentioned shaft, and by means of suitable gearing and jaw clutches operated by a hand-wheel conveniently placed at the side of planer, this sleeve and pulley may be driven at any one of four speeds by the inner shaft, thus giving for a return table speed of 70 feet a minute, forward speeds of 35, 27, 20 or 15 feet a minute. If inner cutting speed variations are desired, they are obtained by varying the motor speed accordingly, the motor being operated on the Crocker-Wheeler multiple voltage variable speed system, an ideal one for any tool whose power demand increases with the speed of operation. This applies particularly where a wide speed range is desired or where there are heavy momentary overloads such as usually occur when the table of a planer reverses.



ELECTRICALLY-DRIVEN PLANER.

Although on this planer but slight variations of motor speed are needed to obtain any desired cutting speed, yet it is often desirable to run the table at very slow speeds, as in setting up work, etc., and then the wide motor speed range is a great convenience, and the size of motor was not increased at all to obtain the variable speed features. The remarkable feature of the equipment is that the reversal of the table, even at the highest speeds, causes practically no peak load on the motor; or stated another way, the ammeter readings for a complete cycle with 8-ton casting on table, running at maximum speeds, are as follows: During cutting stroke, 50 amp.; at reversal, 75 amp.; during return stroke, 70 amp.; at reversal, 70 amp. Thus it requires hardly any more power to reverse than it does to move the table during the return stroke, which means that a considerably smaller motor can be used than would otherwise be necessary. This desirable result has been obtained by making but a few slight alterations in a standard planer, the main points being the use of a proper sized fly-wheel, the proportions of the lower driving pulleys and the use of the lightest weight pulleys consistent with strength. The two latter changes cause the reverse to take place quickly, smoothly and without any of the customary objectionable shrieking of belts.

The total work done in stopping and starting the moving parts at each reversal (this work being transformed into heat that destroys the belts) is but one-third of that which is wasted where the design is the customary one for planers of this size. Although the planer has been used chiefly on very short stroke work for the last six months, it has been found unnecessary to employ the belt tightening idlers intended for use in case the extremely hard duty should cause the belts to stretch unduly. This interesting machine is the result of extensive experiments and study of the problem made by the Crocker-Wheeler Co. in the course of its investigations into the subject of motor-driven machine tools.

Steam Turbine Condensing Outfits.

At the present time much interest centers in the steam turbine, which promises to reduce the weight and cost of prime movers. Two large machines of this type are on exhibition in Block 51, aisle 1, and Block 44, aisle 10, Machinery Building, at the St. Louis Fair, one being shown by the Westinghouse Machine Company and the other by the General Electric Company. Economic utilization of the energy of steam requires its expansion to the lowest possible pressure, which in the turbine is accomplished without the usual losses due to the corresponding extremely low temperatures. In actual service the economy of the turbine is increased by approximately 3 to 5 per cent. for each inch of vacuum higher than 26 inches. It is therefore of vital importance that all losses should be reduced to a minimum. The absence of oil from the steam renders the use of a surface condenser desirable in places where the saving of condensed steam is important. The fact that the final temperature of the condensing water must be comparatively low necessitates the highest degree of efficiency in its use and the immediate and complete removal of all non-condensible vapors, whose presence would increase the absolute pressure and consequently reduce the efficiency of the turbine.

The steam from the Westinghouse-Parsons turbines at Block 51 is condensed in a 1,500 square foot surface condenser, supplied by Henry R. Worthington. The air is removed by a Worthington rotative dry vacuum pump of the center crank type, but similar in other respects to the horizontal pumps already described. An air cooler is interposed between the condenser and the vacuum pump, considerably increasing the capacity and efficiency of the latter. The condensed steam is removed from the condenser by a Worthington volute pump directly connected to an induction motor. The operation of this pump is very interesting, since it requires neither valves nor floats and is not subject to vapor binding, as are reciprocating pumps. The pump is placed below the level of the condenser, receiving the water by gravity, and its capacity is such that it runs ahead of the supply, so that the suction pipe is never full. The discharge pipe is, however, always full and pressing back against the pump, but so long as the latter is in motion there is no possibility of the water passing back to the condenser, so no automatic devices are needed. In another turbine plant a pump of this character returns the hot water directly from the surface condenser to the boiler against a pressure of 250 pounds.

The Curtis steam turbine, exhibited by the General Electric Company in Block 14, is of the vertical type, and the condenser is placed in the base of the steam turbine. It contains 8,000 square feet of tube surface and was built by Henry R. Worthington. The air is removed by a rotative dry vacuum pump, similar as regards the air end to those heretofore described, but driven through the medium of a silent chain by an electric motor.

Lighting All Trains.

The New York, New Haven & Hartford Railroad Company, it is stated, is now equipping its passenger cars with storage batteries, which will furnish light for all trains between New York and Boston. Freedom from danger of fire in case of accident is given as the chief cause of installing the new method of illumination, but the advantages of electricity and the fact that it may be split up into small units and placed in berths and other desired places have also been considered in making the change.

Storage Battery Locomotive at St. Louis.

In the Court of the Palace of Electricity there is an exhibit and demonstration of a very practical "Industrial" railway and locomotive, the design of the C. W. Hunt Company, West New Brighton, Staten Island, N. Y. The locomotive is of the narrow-gauge electric storage battery type, and is especially designed for use with "industrial" railways in machine shops, factories, storage yards,

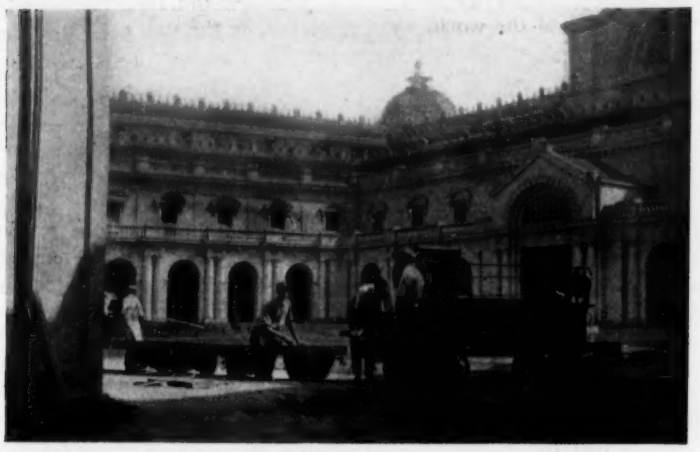


FIG. 1.—EXHIBIT OF C. W. HUNT CO., COURT OF PALACE OF ELECTRICITY.

smelting and refining plants, steel works, shipbuilding yards, wharves, plantations, lumber mills and wherever it is designed to handle economically material from one part of a plant to another. The gauge of the road at the Exposition is 21½ in., which is the standard of the "industrial" railroads built and laid by the C. W. Hunt Company, and with which it is possible to operate around curves of 12 ft. radius, thus enabling any part of the works of a factory to be reached, a matter of importance for manufactories with irregularly placed buildings. The Hunt electric storage battery locomotive consists in construction of a storage battery, which fur-

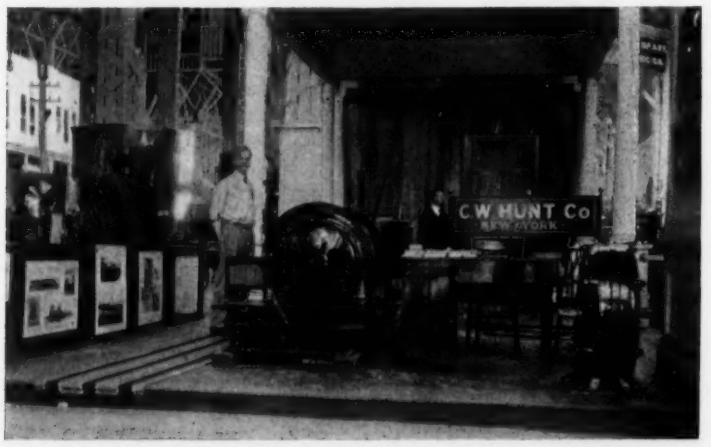


FIG. 2.—C. W. HUNT CO.'S EXHIBIT, PALACE OF ELECTRICITY.

nishes power to two independent motors. There are eight driving wheels to the locomotive, and the design is such that all of the wheels are used as drivers, thus securing a maximum tractive effort and a duplication of mechanism. The motors are made by the Westinghouse Electric Company, and possess high electrical efficiency.

In the Electricity Building the company is exhibiting a straight line electric hoist, together with photographs of plants which have been equipped with their coal-handling machinery, a line of manufacture in which the company was the pioneer. Engineers interested in steam power plants will find these photographs unusually interesting.

Pothead Bracket for Telephone Cables.

A new form of pothead bracket for telephone cable construction work has just been brought out by the F. Bissell Co., of Toledo, Ohio. The "Security" bracket is made of malleable iron. Its attachment to the pole is easy. A ⅜-inch pole is started 3 or 4 inches deep, into which is driven a barbed shank. Removing the outside clamp *A*, a head *B* is seen, on which to pound. This is driven in until the foot of the brace *C* enters the pole. Then *C* is hit vigorously in order to make sure of a firm step. The cable is put in the bracket, and the clamp *A* is placed around it, the two bolts *D* being loosely fastened. The nuts come against the shoul-

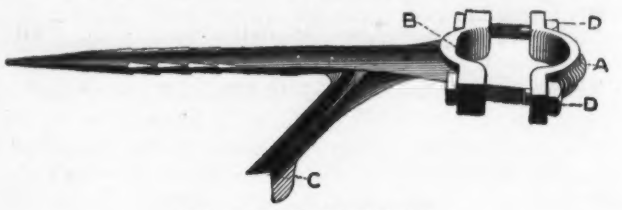
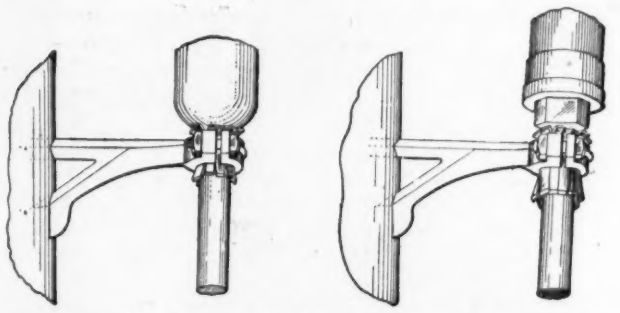


FIG. 1.—POTHEAD BRACKET.

ders and face in with the heads fronting out, which makes a better job. Shims of lead or leather are put between the bracket and the cable so that the lead cable is cushioned. The bolts *D* are then tightened firmly, but not enough to crush the cable.

The clamp should be put around the cable itself and the pothead should be just above it. This puts the strain on the lead sheath and not on the pothead. If it does slide down no particular harm is done, although the first hold is better.

Linemen can swing or stand on this bracket without injury to it or to themselves. It neither breaks nor decays. It is altogether



FIGS. 2 AND 3.—OLD AND NEW POTHEAD BRACKETS IN POSITION.

permanent and in appearance is a great improvement, and the saving in expense is considerable. Samples will be sent anywhere subject to approval.

Two sizes are made, one with an opening of 1⅝ and the other opening 2¼; deducting ⅛ on each side for the shim gives a maximum cable capacity of 1⅜ and 2 inches respectively. Both may be shimmed to fit smaller diameters.

Engine Type Generator.

The Sprague Electric Company has for many years been remarkably successful in the design and construction of high grade elec-

ENGINE TYPE GENERATOR.

trical apparatus. It now calls special attention to the accompanying illustration of its M. L. engine type generator, which has been in actual service for several years.

This generator was designed to meet the requirements of modern

practice and satisfactorily demonstrates the claims of the manufacturers to high efficiencies, low temperatures, sparkless commutation, compactness, great strength and endurance. The highest class of workmanship and material is used in the construction of the generator, thus insuring best possible commercial value to the purchaser.

Electrical Exhibits at the Minnesota State Fair.

One of the important events of each year in Minnesota is the State Fair held in the late summer or early fall in St. Paul. Permanent buildings occupy a large tract of land in the Midway District between the Twin Cities, and low railroad rates enable large numbers of citizens of Minnesota, Wisconsin, Iowa and the Dakotas to attend. While the Fair is primarily devoted to the exhibition of the agricultural and manufacturing products of the State, there has grown in recent years an extensive exhibition of both the heavier and lighter farming machinery; and along with this development various electrical matters are brought to the attention of visitors. This year the Fair was held from Aug. 29 to Sept. 3 inclusive, and although the electrical exhibits were somewhat scattered, they proved of considerable interest.

Perhaps the most notable illustration of the usefulness of electricity on the farm was given by the telephone. The Northwestern (Bell) Telephone Exchange Company installed a central office upon the grounds having connections with all parts of the country through the regular toll lines, and the features of modern Bell practice were much in evidence. The Twin City Telephone Company—an independant organization serving St. Paul and Minneapolis, with many towns in the Northwest—also had a central office in working order, in the main building of the Fair. Associated with this company's exhibit of a 4,800 line common battery, lamp signal, three-position switchboard in one section, with three telephone booths was the Stromberg-Carlson Company's booth. This booth contained the Twin City apparatus as a working exhibit, besides different styles of wall sets, switchboard for rural lines, private branch exchanges and small towns, a 40-volt battery, distributing frames, table of relays, receivers, transmitters, keys, cable sections, etc. The back of the operating switchboard was open for the inspection of the public, and an ample supply of literature was at hand for free distribution, discussing the advantages of the telephone in farm life.

A noteworthy exhibit was that of the Vought-Berger Company of La Crosse, Wis. This was installed in a special tent near the main building, and was in charge of J. G. Ball, of Fargo, N. D. Some 15 different styles of wall instruments were shown here, with the desk stands, keys, solid back, transmitters, receivers, etc. manufactured by the company. A self-restoring drop combination switchboard telephone for rural lines was shown, with a magneto switchboard at its side. Suspended from the top of the tent was one of the company's pendant telephones, designed chiefly to enable business men to use their entire desk space, part of which is generally occupied by the telephone. The action of pulling down the handle carrying the receiver and transmitter calls the central office. This type of instrument finds special favor with doctors, who hang the instrument over their beds at night in order to respond quickly to calls. The suspending cords are composed of insulated conductors flexibly wound about cores of steel piano wire, each conductor having a separate steel wire core.

Another interesting exhibit was that of the McClintock Mfg. Co. of St. Paul, which showed a device to be placed in locomotive cabs for the purpose of warning engineers of danger and thereby preventing wrecks. The alarming device consists of bells and incandescent lamps in the cab, the apparatus being operated through the agency of two small auxiliary rails running parallel to the main track. These rails are divided into blocks which overlap so that two trains cannot get closer to each other than one-half the length of the blocks without the alarms being sounded in the cabs of both engines. The connection with the auxiliary rails is made by cast iron shoes attached to the locomotive, and the system is so arranged that station agents and engineers can communicate when running or standing still, through keys in the cabs and at stations. By means of fusible plugs and small mechanical devices placed on bridges and culverts a circuit is closed between the main and auxiliary rails in cases of fire or high water, thereby warning the engineer as soon as he enters the block in which the trouble is located. Current is supplied by small dynamos located in the locomotive cabs. The space required for the apparatus in the cab is about 10 by 10 8 inches. Two small locomotives were equipped with the apparatus in the exhibit, and were frequently operated.

An exhibition of apparatus and methods was also given by the Wallace School of Telegraphy, of St. Paul. Relays, sounders, keys, hoods and the various other familiar equipments of telegraphy were shown in working order. Telegraph offices were also maintained for commercial service on the Fair grounds, and frequent bulletins of the news of the world were displayed by the various Twin City newspapers. The different departments of the Fair were connected likewise by telephone. Various small electrical supplies in the way of flash lights, etc. were also exhibited.

Once of the most striking exhibits was that of Messrs. Dodd & Struthers, of Des Moines, Iowa, manufacturers of an improved form of lightning rod made up in a bare copper rope of thirty stranded wires. A static machine was arranged to produce an artificial lightning storm by being connected to two metal plates, one of which represented a charged cloud and the other the earth. Small models of houses, barns, churches and pewter figures of human beings were set up by the exhibitor after the manner of every day life, and the effects of the discharge noted with and without properly grounded lightning rods. The apparatus enabled the spectators to see just what could be done on a small scale in the way of lightning protection and demonstrated the relative safety of different parts of buildings in an interesting manner. This exhibit was one of the most popular on the grounds.

Among the more recent developments in improved electrical apparatus the exhibit of Jeremiah King, of St. Paul, occupied a noteworthy place. The apparatus shown consists of an improved form of elevator signal, designed to do away with the expense of maintaining wire cables in elevator shafts. The matter of keeping an elevator signal or bell in order has always been a troublesome one for all concerned, and the expense and loss of time resulting has frequently been considerable, particularly in handling freight elevators, where employes have sometimes been kept waiting many minutes on account of the breakage of the ordinary wire cables used in signalling. The apparatus shown by Mr. King consists of four No. 10 B. & S. uninsulated copper wires and a brass standard carrying four small pulleys or trolley wheels which are held against the wires by small weights and guards. The four wires run the entire vertical length of the elevator shaft, close to the wall. They are fastened at the top by steel hooks, and after passing through two eyes at the bottom are held in place by 8-lb. weights, which keep them taut at all times. As the elevator runs up and down the wheels run on the wire, giving at all times a perfect contact, regardless of whether the car is in motion or not. One pair of wires is devoted to bell signals and the other to the elevator lights. The apparatus is also applicable to mining telephone work, the elevator operator and engine room employes being in ready communication through the wires and wheels. For office building use the apparatus that holds the wheels is nickel plated and mounted on top of the elevator. It occupies little space and can easily be lifted by hand. The four wheels are run on case hardened shafts and require a little oil about once in four days, which is practically all the attention needed. One of these signals is installed in the Pioneer Press Building and another in the building of the West Publising Co., of St. Paul.

Any mention of the electrical exhibits of the Minnesota Fair would be incomplete without a reference to the admirable terminal facilities constructed for the first time this year by the Twin City Rapid Transit Company. In former years there had been no small discomfort and annoyance from overcrowding of would-be passengers at the Fair. This year the company built a terminal in the heart of the grounds, some 600 feet long by 300 wide, containing two loops and ten stub tracks with crossovers and switches. One loop was devoted to St. Paul traffic and the other to the needs of Minneapolis people. At the close of each performance in the afternoon and evening on the grounds there were thus available some 150 cars for immediate occupancy, so that certainly 15,000 to 20,000 people could have been cared for immediately if the weather had been unpropitious—a striking instance of the value of forethought and progressiveness. To an electrical engineer visiting the State Fair in Minnesota this year this feature was perhaps the most interesting of all the many exhibits of instructive industry in the Northwest.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Speculation was quite active, though movements in various stocks continued to be manipulative despite the easy money market. United States Steel issues were strong on reports of an agreement with independent producers. The industrials were rather inactive and the manipulation in Amalgamated Copper seems to be suspended for the present. In the traction group there was less bullish interest owing to the apparent surrender of the Manhattan-Interborough interests to their employes, who threatened to strike for a higher wage-scale. There was active trading in Brooklyn Rapid Transit, which closed at 56⅞, a net gain of 1½ points. Of this stock 104,700 shares were sold. Metropolitan Street Railway touched 122⅞ during the week, but receded and closed at 121, a loss of ½ point. The electrics were active and strong and substantial gains in prices are noted. Allis-Chalmers pfd. closed at 50½, which is an advance of ½ point; General Electric at 174½, a gain of 5½ points, and Westinghouse common at 164, an increase of 1 point. Westinghouse pfd. made a gain of 5 points, closing at 190. Western Union is slightly higher at 91½, and Am. Telephone & Telegraph advanced 2⅜ points to 140, at which figure it closed. The market for outside securities presented no features of note. Following are the closing quotations of September 13:

NEW YORK

	Sept. 6	Sept. 13		Sept. 6	Sept. 13
Allis-Chalmers Co.	11	11	Electric Vehicle	12	15
Allis-Chalmers Co. pfd.	50⅛	48	Electric Vehicle pfd.	17	20
American Tel. & Cable.	89	89	General Electric.	169⅛	172
American Tel. & Tel.	137	139	Hudson River Tel.	..	..
American Dist. Tel.	22	23	Interborough Rap. Tran.	146	145⅛
Brooklyn Rapid Transit.	55⅛	54⅞	Metropolitan St. Ry.	120⅛	121⅝
Commercial Cable.	185	190	N. Y. & N. J Tel.	..	156
Electric Boat	39	40	Marconi Tel.	..	..
Electric Boat pfd.	70	71	Western Union Tel.	91	91¾
Electric Lead Reduction.	⅜	*1⅛	Westinghouse com.	161⅛	162½
			Westinghouse pfd	190	180

BOSTON

	Sept. 6	Sept. 13		Sept. 6	Sept. 13
American Tel. & Tel.	137¼	139	Western Tel. & Tel. pfd.	90	89
Cumberland Telephone.	117¾	118	Mexican Telephone.	1⅛	1⅛
Edison Elec. Illum.	259	*260	New England Telephone.	126	130
General Electric.	169	171½	Mass. Elec. Ry.	12¼	12¼
Western Tel. & Tel.	13¼	13	Mass. Elec Ry. pfd.	60¼	58¾

PHILADELPHIA.

	Sept. 6	Sept. 13		Sept. 6	Sept. 13
American Railways.	48¼	48¾	Phila. Traction.	99¼	97⅝
Elec. Storage Battery.	64¼	66	Phila. Electric.	6¾	7
Elec. Storage Battery pfd.	64¼	66	Phila. Rapid Trans.	14¾	16¼
Elec. Co. of America.	9¼	9¼			

CHICAGO

	Sept. 6	Sept. 13		Sept. 6	Sept. 13
Central Union Tel.	..	..	National Carbon pfd.	*115	107
Chicago Edison.	150	..	Metropolitan Elev. com.	21	21½
Chicago City Ry.	183	182½	Union Traction.	7	6
Chicago Tel. Co.	..	122	Union Traction pfd.	31	.
National Carbon.	40	35			

* Asked

ST. LOUIS TRANSIT EXTENSIONS.—The president and directors of the St. Louis Transit Company have called a meeting of stockholders for October 19 to pass upon a proposition to cancel the issue of $20,000,000 improvement and refunding bonds authorized last May, and to issue in lieu thereof bonds not exceeding $12,500,000. The object in authorizing the issue of $20,000,000 bonds last May was to retire certain obligations arising from deficits and improvements which the Transit Company had incurred in the course of its existence. The bonds were to be guaranteed by the United Railways Company, of which the Transit Company is, in a measure, a subsidiary organization. It is stated that arrangements have been made by which the Transit Company will issue only $10,000,000 bonds, as the cost of the proposed improvements have not been as great as estimated, and the collateral loans coming due in November for $6,000,000 can be retired from the difference between the cost of the improvements and the total of the bonds, which, it is believed, will, under the existing market conditions, bring a good price. Brown Bros. of New York have done much toward financing the Transit Company, and have disposed of some of the bonds, though arrangements with the purchasers can be made on the new basis. Another feature which it is believed will be considered is that in all probability the Transit Company will be able to wipe out its deficits this year by its net earnings.

DIVIDENDS.—Directors of the General Electric Company have declared the regular quarterly dividend of 2 per cent., payable October 15. The directors of the United Railways Company, of St. Louis, have declared the regular quarterly dividend of 1¼ per cent. on the preferred stock, payable October 10. The Western Union executive committee has recommended the declaration of the regular quarterly dividend of 1¼ per cent. Twin City Rapid Transit directors have declared the regular quarterly dividend of 1¾ per cent. on the preferred stock, payable October 1. The directors of Otis Elevator have declared the regular quarterly dividend of 1½ per cent. on preferred stock. The directors of the Safety Car Heating & Lighting Co. have declared the regular quarterly dividend of 2 per cent. on the capital stock, payable October 1. The company has been paying an extra dividend of 1 per cent. each quarter, but the extra is dropped this time. The directors of United Traction & Electric Company, of New Jersey, have declared the regular quarterly dividend of 1¼ per cent., payable October 1. Commercial Cable directors have declared the regular quarterly dividend of 2 per cent., payable October 1.

BIRMINGHAM, ALA., TELEPHONE.—The stockholders of the People's Telephone Company, of Birmingham, Ala., have decided favorably on the proposition to cancel the present authorized issue of bonds for $100,000 and an issue of $200,000 worth of 5 per cent. 20-year gold bonds is authorized. The new bonds will be first mortgage bonds and will be secured by trust deed or mortgage of all the company's property and franchises. The proceeds of said issue will be used to pay off the present indebtedness of the company and provide funds for the growth and extension of the plant.

NATIONAL BATTERY CAPITALIZATION.—The National Battery Company of New York has filed a certificate of increase of capital stock from $500,000 to $1,000,000. The new issue is to be 6 per cent. preferred stock. Among the directors are R. L. Coleman, W. H. Miller, George Pope and Paul Walton.

ST. JOSEPH, MO., BONDS.—The Mississippi Valley Trust Company has purchased the $325,000 issue of St. Joseph, Mo., improvement bonds, $250,000 of which will be spent in the construction of a sewage system and the balance in the construction of an electric lighting plant. The entire issue will bear 4 per cent. interest and mature in 20 years.

Commercial Intelligence.

THE WEEK IN TRADE.—Trade reports, crop reports and industrial developments during the week were generally favorable. Most markets have improved on account of fall and winter trade distribution, and in the industries less strain is noted. In iron and steel, past and prospective price reductions have encouraged inquiry; consumption exceeds production and stocks of crude material are diminishing. The feature was the reduction in steel plates, structural material and wrought pipe, following decreases in wire and nails. At the West a fair business was done in steel rails. More is doing in bituminous coal in the West, but the production of anthracite in August was 16 per cent. less than the same month last year. Collections have improved and better railway returns are made as a result of the beginning of the crop movement, which is stated to be reasonable heavy for this period of the year. Bradstreet's states that more is doing in lumber and hardware at all Western points; on the Pacific Coast staple articles are in better demand and collections have improved, but at Eastern points the improvement is less perceptible, although jobbing business is fairly satisfactory. A number of cotton mills have resumed operations, notably in Rhode Island and Massachusetts, although the tie-up in Fall River continues. Southern trade is expanding as the season advances. Business failures during the week ending September 8, according to Bradstreet's, numbered 144, against 189 the week previous and 165 the same week last year. There was little interest in the copper market, and prices are unchanged, Lake being quoted at 12⅝ to 12¾c.; electrolytic, 12½ to 12¾c., and casting stock, 12⅜ to 12½c.

ANOTHER MEXICAN WATER POWER PROJECT.—The construction of an extensive hydraulic plant to supply the Mexican cities of Parral and Jimenez with power for lighting purposes, etc., is contemplated by Ramon F. Lujian and Julio Muller, who are large owners of land in the State of Chihuahua. They have acquired an extensive ranch on the Rio del Valle, where a good-sized waterfall is available.

INSTALLATION AT THE MINNESOTA STATE CAPITOL.—The new Minnesota State Capitol, at St. Paul, Minn., which has been in process of construction for the past few years, is now nearly completed. This building, containing about 4,000,000 cu. ft. of contents, is heated and ventilated by the fan system of forced air circulation, lighted by electricity, provided with hydraulic elevators, and in every particular is thoroughly modern in design and construction. The heating and ventilating apparatus is grouped at five points, each apparatus consisting of a 9x4½ electrically driven Sturtevant steel plate fan, the combined normal capacity of which is 225,000 cu. ft. of air per minute, and a Sturtevant heater of ample capacity. These apparatus are operated in connection with five ventilating fans exhausting air from the various rooms. The electric lamps for illuminating purposes require an equivalent of 7,000 16-candle-power lamps. The power house is about 367 ft. away from the main building, and is connected to it by means of an underground tunnel. The boiler plant consists of 4 water-tube boilers, built by the Erie City Iron Works, draft for which is supplied by 2 7 ft. Sturtevant induced draft fans driven by direct-connected Sturtevant engines. The chimney is but 15 ft. above the roof, and conforms harmoniously with the style of architecture of the main building. These induced draft fans are so arranged that they may or may not be used with the economizers, and have a capacity to deliver 16,000 cu. ft. of air at 60 degrees or 33,000 cu. ft. if the gases of combustion are at 400 degrees, allowing 18 lbs. of air per lb. of coal.

BROOKLYN RAPID TRANSIT is making large expenditures for improvements. It is estimated that the total amount will run well into the millions, about $4,000,000 having already been spent for new rolling stock alone. A conservative estimate places expenditures within the last few years at from $10,000,000 to $12,000,000. Probably the most important improvement has been the completion of the great central power station at Third Street and Third Avenue, and the putting into full operation of the eight 4,000 hp units installed there. About midsummer, 1905, the road will be in possession of 357 standard motor cars and 270 trailers. The motor cars will have the multiple unit control system, motors and automatic couplers, rendered fireproof at a cost of $1,500 each. Included in this total of elevated cars are 120 open cars which can be converted for winter use and which were purchased by the company last year. There are also to be delivered to the company, at a cost of $1,000,000 or more, 100 new motor cars for the elevated service, these being steel framed and of the most modern type. Two hundred closed cars have been recently added to the equipment of the surface lines, making possible the removal from service of some very old stock.

DODGE & DAY, engineers, Philadelphia, Pa,, have been commissioned by Alexander Bros. to take charge of the electrical installations in the property recently acquired by them at 406 North Third Street, Philadelphia, Pa. A generator will be required, several motors, switchboard, line-shafting, wiring, etc. These engineers have just placed orders for two horizontal high-speed engines, 160 and 240-hp, respectively, with Ames Iron Works, Oswego, N. Y.; 600 hp of tubular boiler with Ervien & Company, Philadelphia, and 100 and 150-kw generators with Crocker-Wheeler Company, Ampere, N. J., for the Victor Talking Machine Company's new plant in Camden, N. J. Other commissions of this firm are the purchase and installation of a night set for the new plant of the Jeanesville Iron Works Company, Hazleton, Pa., and the running of a transmission line to Jeanesville (a distance of 2 miles) to furnish illumination for the town and residences; heating system for residence of James C. Haydon, Jeanesville, Pa.; automobile garage and electrical equipment thereof for Link-Belt Engineering Company, Nicetown, Pa. Specifications on these latter are not ready yet.

FRESH CAPITAL AND NEW NAME FOR STILWELL-BIERCE & SMITH-VAILE COMPANY.—The Stilwell-Bierce & Smith-Vaile Company, of Dayton, Ohio—all its manufacturing lines, goodwill, patents, drawings, etc.—has been purchased by Col. J. D. Platt, president of the Barney & Smith Manufacturing Company, of Dayton. Col. Platt has organized a company called the Platt Iron Works Company to carry on the enterprise. The purchase price was in the neighborhood of $750,000. The new company has a cash working capital of $400,000. The company will take over all the unfinished contracts of the Stilwell-Bierce & Smith-Vaile Company. The personnel of the engineering and sales departments will remain practically the same as heretofore. Mr. Geo. W. Neff is the Eastern manager of the company. The New York offices and warerooms are at 93 Liberty Street.

AIR POWER PLANT CONTRACT.—S. Pearson & Son, Incorporated, who are building the Pennsylvania Railroad tunnels under the East River and Long Island City, have awarded the contract for two complete compressed air power plants, ready to operate, to the Ingersoll-Sergeant Drill Company, of New York. The order includes eight low pressure Corliss compressors and four high pressure compressors, with the necessary boilers, condensers, pumps and an elaborate system of piping. This is the largest order of its kind ever placed. The same company recently obtained an order from the O'Rourke Engineering & Construction Company for two compressed air power plants, to be used in building the Pennsylvania Railroad tunnel under the Hudson River.

NEW EDISON WATERSIDE PLANT.—The New York Edison Company has awarded the contract for the steel to be used in the construction of its huge new power station to be built opposite its present Waterside plant. The contract was allotted to Post & McCord, of New York. It calls for upward of 10,000 tons of steel. The material will be rolled at the Carnegie Homestead mills and and finished at the Ambridge, Pa., plant of the American Bridge Company. Delivery will begin in the late spring. It is expected that the new station will be completed by the end of next year. The plans, etc., for the buildings are understood to have not yet been fully determined upon. Neither has it been decided to install reciprocating engines or turbines.

GOULD STORAGE BATTERY PLANTS.—Mr. W. W. Donaldson advises us that among the contracts secured recently by the Gould Storage Battery Company are the following: City & Suburban Ry. Company, Portland, Ore., 280 cells and regulating booster; Edison Electrical Illuminating Company, Topeka, Kan., 280 cells and regulating booster; Leominster, Shirley & Ayer Street Ry. Company, Shirley, Mass., 224 cells; Corporation of the Town of Port Arthur, Port Arthur, Canada, 240 cells; and the following isolated plants: Dr. A. White, Palmyra, Mo.; F. Parks, Westfield, Mass.; Kent County Home, Grand Rapids, Mich.; F. Wesel Mfg. Company, Brooklyn, N. Y.; Thos. W. Byrne, Plymouth, Mass.

HAMILTON CORLISS ENGINE ORDERS.—The Hoover Owens, Rentschler Company, of Hamilton, Ohio, has secured a contract for a 1200 hp Hamilton Corliss cross-compound engine, to be directed connected to a direct current 800 kw General Electric generator, for installation in the Zylonite power station of the Hoosac (Mass.) Street Railway Company. A 400 hp Hamilton Corliss engine has also been ordered for installation in the Broadway Rouss store, New York. The generator will be built by the General Electric Company. This outfit will be used for lighting purposes. These contracts were secured through Mr. W. B. Mayo, the New York manager of the company.

THE NORTHERN ELECTRICAL MFG. COMPANY, of Madison, Wis., has been awarded the contract for the entire motor equipment of the new shops of the Southern Railway Company, at Spencer, N. C., designed by Mr. S. D. Cushing, signal and electrical engineer of the Southern Railway Company. About 450 hp of motors will be required. A combination of group and individual drive will be used, and all motor-driven tools requiring speed variation are to be equipped with Northern two-wire, variable speed motors. The Northern Electrical Mfg. Company will also furnish a 50 kw generator for lighting the shops of the company at Alexandria, Va., and it has also recently sold to Greenlee Brothers, of Chicago, Ill., a 200-kw generator for the equipment of its plant at Rockford, Ill. This is a representative sale and indicates the rapidly extending field of application of Northern apparatus in all sorts of industrial plants. The water works company of the City of Fond du Lac ordered a 90-hp vertical Northern motor for pumping service. This motor is to be used for driving a propeller type of deep well pump.

WESTINGHOUSE ELECTRIC ACTIVITY.—The last two weeks' pay at the Westinghouse Electric & Manufacturing plant at East Pittsburg was larger by $30,000 than any time this year. The sum paid was $276,000, which has been exceeded only twice, in 1902. The shops are running full and employ almost 9,000 men. They will be visited next week by the foreign guests of the American Institute of Electrical Engineers.

THE JOHNS HOPKINS HOSPITAL, Baltimore, Md., is having installed by the Chesapeake & Potomac Telephone Company a complete private branch exchange telephone system. The departments, wards and hospital buildings are being equipped with telephones. The telephone instruments are finished in white enamel and every precaution has been taken to render them sanitary throughout.

U. S. LIGHT & HEATING COMPANY.—Philadelphia interests are rumored to have secured the United States Light & Heating Company, which has equipped the Empire State Express cars with its electric lighting system; also the dining cars of the Lackawanna.

LIGHTING PLANT FOR HOTEL ENDICOTT.—A lighting plant is to be installed in the Hotel Endicott, Columbus Avenue and 81st Street, which will consist of a 160 hp American-Ball duplex engine direct connected to a 100 kw Western Electric generator.

General News.

THE TELEPHONE.

TALUCAH, ALA.—The Intercounty Telephone Company has been incorporated with a capital stock of $2000. The directors are C. B. and E. C. Hagepoom and others.

AUGUSTA, ARK.—The M. H. Patterson Telephone Company has bought the Cotton Plant system from the Clarendon Telephone Company and has also bought the Augusta Telephone Company.

CORDELE, GA.—The Farmers & Business Men's Telephone Company has been granted a franchise at Cordele, with J. C. Ledbetter as the chief promoter.

WAVERLY, ILL.—The Waverly Telephone Company has increased its capital stock from $35,000 to $50,000.

ST. JOSEPH, ILL.—The St. Joseph Telephone Company has been incorporated with a capital stock of $18,000. The incorporators are N. C. Hoyt, U. G. Glasscock and O. C. Boggs.

PEORIA, ILL.—It is reported that the Central Union Telephone Company has purchased 80 per cent. of the capital stock of the Interstate Independent Telephone & Telegraph Company.

DIXON, ILL.—The Lee County Telephone Company is to rebuild its systems of telephones, both in the city and throughout the country districts. The contemplated improvements will cost nearly $75,000.

QUINCY, ILL.—The Adams, Pike County & Hannibal Telephone Company has been incorporated with a capital stock of $7000. The incorporators are W. H. Breckinridge, John W. Buttz, S. S. Inman and Chas. H. Rankin.

ALTON, ILL.—Efforts are being made, it is said, by the Bell Telephone Company, to consolidate the farmers' system of telephones in Madison County with its own. The farmers claim to have 13,000 telephones in use, and it is proposed to establish an exchange in Bethalto, where connection could be made between the two systems.

BOISE, IDA.—The district judge has handed down a decision holding that the Rocky Mountain Bell Telephone Company is not legally entitled to transact business in the State, having failed to comply with the law requiring the filing of articles of incorporation. The ajrmation of the decision by the Supreme court, to which an appeal will be made, will mean the invalidating of all the contracts with the company in Idaho.

IDAVILLE, IND.—The Idaville Co-operative Telephone Company has elected the following officers: President, W. Pearson; vice-president, T. B. Grime; treasurer, J. Raff; secretary, L. Read, and manager, F. Roger.

CRAWFORDSVILLE, IND.—The Bell Telephone Company has made a start toward the improvement of its plant and standing in this community. It will install the central energy system, the switchboard alone costing $15,000.

MONROEVILLE, IND.—The Monroeville Home Telephone Company has increased its capital stock $50,000, making a capital of $75,000. The purpose is to make improvements and extensions to the system. George E. Spoke is secretary.

BICKNELL, IND.—The Citizens' Telephone Company has been incorporated with a capital stock of $10,000. The directors are R. H. Pickel, J. T. Philippi, Harmon Buck, J. L. Donaldson, E. T. Cox, Chas. Harting and W. J. Huff.

WEST UNION, IA.—The Rogers Telephone Company has been incorporated with a capital stock of $50,000. Jas. S. Clarkson, surveyor of customs of the port of New York and ex-Senator Chas. Towne, of New York, are among the incorporators.

LEAVENWORTH, KAN.—The contract for the erection of the new office building for the Missouri & Kansas Telephone Company has been awarded to Robert Yoakum. The building is to cost $9000.

STOCKTON, KAN.—The Woodston Mutual Telephone Company has been formed for the purpose of building two lines into Stockton. Arrangements are being made to co-operate with the Stockton and Webster exchanges and rural lines.

SCOTTSVILLE, KY.—The Scottsville & Bethlehem Telephone Company has been incorporated with a capital of $100,000. The incorporators are S. J. Reed, W. E. Stephens and others.

OAKLAND, MD.—The Red House Telephone Company, of Garrett County, has been organized. Henry Sisler, of Red House, is president; Mr. Arnold, of Wilson, is vice-president, and P. F. Snyder is secretary.

WILLIAMS, MICH.—The Williams Telephone Company has purchased the Marshall Telephone Company's system.

GRAND RAPIDS, MICH.—The West Michigan Telephone Company has been sold out to the Citizens' Telephone Company. A large number of improvements will be made.

GRAND LEDGE, MICH.—Residents of Grand Ledge and vicinity are planning to form a telephone company with a capital stock of $10,000 to cover the country surrounding the Eaton County town with a telephone system.

BREWSTER, MINN.—A franchise has been granted to the Minnesota Valley Telephone Company to install an exchange at Brewster.

LAC QUI PARLE, MINN.—The Farmers' Mutual Telephone Company has been incorporated with a capital stock of $20,000. The incorporators are Henrik Johnson, C. A. H. Holton, H. C. Thorson, E. Ekeland, Julius Skoien, Peder P. Smaagaard, John J. Skobba and Anton S. Mueller, of Madison, and Ole Holton, of Dawson.

BOONVILLE, MISS.—The Boonville Telephone Company has been organized with a capital stock of $10,000. B. F. Henning, of Boonville, is interested.

CARROLLTON, MO.—The Central Telephone Company has increased its capital stock from $2000 to $4000. Its headquarters are in Mandeville.

LINCOLN, NEB.—The Leigh Independent Telephone Company has been incorporated with a capital stock of $15,000. The incorporators are Frank E. Bell, H. W. Graves, H. P. Buhman, J. H. Lowery and Julius H. Pieper.

NORTH CREEK, N. Y.—The North Creek Telephone Company has been incorporated with a capital stock of $10,000. The directors are C. A. Pereau, W. T. Campbell, J. L. Fuller, John Little and Albert E. Prescott, of North Creek; H. Prior King, of Glens Falls and Embury Morton, of Weavertown.

UTICA, N. Y.—A movement is under way to incorporate all the independent telephone companies in Central New York under the name of the New York Independent Telephone Company. Besides the local company the more prominent ones which would become a part of the system are the Rome Home Telephone Company, Herkimer County Telephone Company, Inter-State Company, of Little Falls, and the Otsego, Clinton, Oneonta and Cooperstown companies.

RENO, NEV.—Work on the reconstruction of the system of the Sunset Telephone Company will be commenced in the near future, equipment for that purpose having already been ordered. The improvements will cost about $30,000.

CHARLOTTE, N. C.—The Bell Telephone Company is dismantling the recently purchased system of the Charlotte Telephone Company. The Bell Company at Charlotte now has 1200 subscribers, a greater number than in any city of the Carolinas, except Charleston.

WINSTON, N. C.—The Southern Bell Telephone Long Distance Company is preparing to build lines from Elkin via Booneville and other points to Winston, N. C.

DINSMORE, N. D.—The Dakota Telephone Company is to install an exchange.

WOODSFIELD, OHIO.—The Buckeye Pipe Line Company has been granted permission to build a telegraph and telephone line here.

MARION, OHIO.—The Marion County Telephone Company is preparing to build an exchange at Waldo, and will connect it with the county system.

MT. VERNON, OHIO.—The Central Union Telephone Company is making extensive improvements at its Mt. Vernon exchange and is installing a common battery switchboard.

CINCINNATI, OHIO.—Numerous citizens in the Millcreek Valley villages are signing a petition agreeing to discontinue their service unless the Cincinnati Bell Telephone continues its former five-cent rate.

BOLIVAR, OHIO.—The Tuscarawas Valley Telephone Company has been incorporated with a capital stock of $2000. The incorporators are Earl Fisher, J. W. Keel, C. J. Pfau, S. B. Hennis and H. S. Fisher.

TROTWOOD, OHIO.—The Trotwood Home Telephone Company has increased its capital stock from $10,000 to $20,000 and will make improvements. S. A. Blessing is president and W. L. Basher, secretary of the company.

JUNCTION CITY, OHIO.—The Rushcreek Telephone Company has been incorporated with a capital stock of $5000. The incorporators are W. S. Tuttle, W. M. Klingler, J. M. Elder, Joseph M. Folk and S. C. Elder.

ALLIANCE, OHIO.—For the second time within two weeks the system of the Stark County Telephone Company was entirely thrown out of service by the switchboard being burned out, caused by a trolley wire crossing a telephone wire. The loss will reach several thousands of dollars.

YOUNGSTOWN, OHIO.—The Central Union Telephone Company will make extensive improvements in Youngstown and vicinity. A large number of cables will be installed, iron wire will be supplanted with copper and the board will be enlarged. A new exchange will be installed at Lowellsville.

CALDWELL, OHIO.—The Caldwell Independent Telephone Company has been reorganized, forming an alliance with the Marietta, Parkersburg & Cumberland Telephone Company. The capital stock has been increased to $50,000 and long distance connections will be made. W. H. Bowron has been elected president and general manager and A. C. Davis, secretary.

CLEVELAND, OHIO.—The United States Telephone Company has completed the construction of three copper trunk lines from Dayton, Ohio, to Richmond, Ind., giving the independent system of Ohio connection with the numerous systems in Indiana. This connection will soon give the independents through connection with Missouri, Illinois and as far west as Topeka, Kan.

NORMAN, OKLA.—The Farmers' Central Telephone Company has been incorporated with a capital stock of $7000. The incorporators are P. N. Haun, W. J. Abshier and others.

BEND, ORE.—The Central Oregon Telephone Company is being organized at Bend by W. E. Guerin and A. L. Goodwillie to construct a line from Bend to Prinville, Ore.

ABERDEEN, S. D.—The Dakota Central Telephone Company has been incorporated with a capital stock of $5,000,000. The directors are J. L. W. Zietlow, W. C. Bicklehaupt, Isaac Lincoln and C. N. Herried.

LEXINGTON, VA.—The Lexington Mutual Telephone Company has been granted a new franchise for a period of thirty years. The company will at once commence the enlargement of its plant at a cost of about $5000. W. S. Hopkins is president, N. C. Watts, superintendent, and T. S. Burwell, manager of the company.

PINE CITY, WASH.—The Interstate Telephone Company has been formed with $5000 capital, to build lines to Thornton, St. John and other points.

RACINE, WIS.—The Union Grove & Paris Telephone Company has been incorporated with a capital stock of $2000, by Henry Branes and others.

SHAW, WIS.—The Shaw Telephone Company has been incorporated with a capital stock of $5000. The incorporators are Chas. Sequin, N. M. Johnson and others.

EDGERTON, WIS.—The Edgerton Telephone Company has increased its capital stock from $6000 to $18,000. F. W. Coon is president and W. A. Shelley, secretary.

ELECTRIC LIGHT AND POWER.

JACKSON, ALA.—Mr. George F. Brockman is installing a hydro-electric plant here. The plant includes a 60-hp Leffel turbine, a 250-volt, direct-current Bullock generator, belted to the turbine; 10 Helios-Upton, 2000-cp arc lamps for street lighting and 800 16-cp incandescents. The rate for street lighting is $75 per year per lamp, from 6 p. m. until midnight, every night. The incandescent service is partly on the meter basis and partly flat rate, at 75 cents per lamp per month. Mr. Brockman expects to start the plant Oct. 5. He is superintendent and electrical engineer, and Mr. B. H. Warren is the owner. Mr. Warren is putting in a grist mill, and expects to install an ice plant next January.

GLOBE, ARIZ.—The Globe Electric Light & Power Company has been incorporated with a capital of $2,000,000, to operate in the mines of Arizona. The company is securing water rights and privileges and franchises to build reservoirs and lay pipes for an extensive system of machinery. Incorporators: Chas. M. Clark, of San Francisco, Cal.; Ira E. Tutt and S. M. Haskins, of Los Angeles, Cal.

SAN FRANCISCO, CAL.—The Standard Electric transmission system of the California Gas & Electric Corporation is again in full running order after a second pipe line break caused by a large rock being dislodged by workmen on the line and striking the pipe. The power house was not damaged by the escaping water.

EUREKA, CAL.—It is reported that the Humboldt County Water & Power Company will shortly commence the construction of a 1000-hp steam plant, and will also develop the water power of Mad River. Steam turbines will be employed. The company expects to supply light and power about Dec. 1. B. Von Homeyer is president.

SAN FRANCISCO, CAL.—The California Gas & Electric Company's gross earnings for the five months ending July 31, 1904, showed an increase of $532,695 over the corresponding period of the preceding year. Profits over cost of operation increased $102,944, and the net surplus over all expenses and charges including proportion of sinking fund increased $81,605.

SAN FRANCISCO, CAL.—The North Mountain Power Company, which is constructing a 65-mile electric power transmission system to operate from Trinity County, Cal., to Eureka, has closed a contract with the Wagner-Bullock Electric Company for additional electric equipment. The apparatus will be manufactured by the Bullock Electric Company. This includes a 500-kw, 6-pole, rotary converter, a starting device, three 190-kw, oil filled, water cooled transformers for 30,000 volts and complete switchboard equipment for the Eureka sub-station.

SAN FRANCISCO, CAL.—The California Gas & Electric Corporation, which recently placed in operation a 5000-kw Stanley, 3-phase generator at the De Sabla power station, will install two additional 5000-kw generating units at the Electra power station. These 3-phase machines will each be direct-connected to a Doble tangential water wheel. It is said that these wheels will be the most powerful of their class in the world. The contracts for the two additional 5000-kw generators will be filled by the Stanley Electric Manufacturing Company, making, with an additional generator for the De Sabla plant, a total of four machines of this capacity for the California Gas & Electric Corporation.

MONTPELIER, IDA.—The Montpelier Electric Light Company has begun work on the construction of a power plant in Georgetown, about 13 miles distant from here. A transmission line will connect this city with the power plant. About $20,000 will be expended in the enterprise.

BOISE, IDA.—The Belle of Thunder Mountain Mining Company has placed with the Boise Electric Supply Company an order for necessary equipment for an electric light plant in that district. On account of the difficulty in shipping supplies to Thunder Mountain, several weeks will probably elapse before the equipment reaches its destination.

MANSFIELD, ILL.—This city has granted a 25-year franchise to E. E. Sayler, of Saybrook, for an electric light plant, and contracted for 15 2000-cp. arc lights for the streets, all night, for 10 years.

WAUKEGAN, ILL.—The North Shore Electric Company, which is controlled by Samuel Insull, and which supplies electric light and power for all the suburban territory north of Chicago, will probably build a large power house at Waukegan near the lake from which current will be transmitted to the various suburbs north of Chicago.

ALTON, ILL.—The Alton Gas & Electric Company was organized here September 6 and the following directors were elected: F. E. Allen and L. C. Haynes, of East St. Louis, W. P. Kennett, of St. Louis, O. S. Stowell, H. E. Weeks, Geo. Kuhn and J. F. Porter, of Alton. A meeting of the directors will be held in a few days to elect the officers. The Alton Gas & Electric Company was organized a few days ago with a capital of $500,000. It was organized to take over the electric, gas-lighting and hot-water heating plant of Alton, formerly owned by the Alton Traction Company. When the latter company was consolidated with the St. Louis & Granite City Street Railway Company, a new corporation was formed, known as the Alton, Granite & St. Louis Traction Company. This company took over the street railway lines of Alton and Granite City and is building an interurban road between the two cities.

RICHMOND, IND.—The Municipal Light Commissioners are preparing to build a dam in the river below the municipal light plant. The real worth of the Richmond municipal light plant is now being tested. The street lighting has been transferred from the private to the municipal company.

WATERLOO, IND.—The Waterloo Water & Light Company is reported incorporated, with a capital of $10,000, to construct a water and lighting plant at Waterloo. Incorporators: Wm. J. Vessey and Chas. L. Alds.

BLOOMINGTON, IND.—The directors of the People's Gas, Electric & Heating Company have decided to issue $400,000 bonds. A new electric light engine room will be erected. W. H. Scott is president.

DANVILLE, KY.—Frank T. Snyder, representing St. Louis, Mo., capitalists, has secured from the City Council a franchise for an electric light and power plant. He has secured a franchise for a street railway, and has asked the Fiscal Court of Boyle County for a franchise to run an interurban railway from Danville to Junction City along the Shelby City pike.

GAITHERSBURG, MD.—The Town Council has under consideration the installation of a new lighting plant.

SPRING LAKE, MICH.—The citizens will probably soon vote on the proposition of establishing an electric light plant.

BROCKTON, MASS.—The consolidation of the Edison Electric Illuminating Company, of this city, and the Whitman Light & Power Company, of Whitman, has been perfected, and stock issued to the amount of $200,000, the increase being $50,000. The officers of the Brockton Company remain practically in control of both plants under the consolidation.

BALTIMORE, MD.—The Electrical Commission will ask for next year an appropriation of $200,000 for 800,000 duct-feet of new conduit construction for the extension of the new subway. This appropriation is to be taken from the $1,000,000 1928 conduit loan. This year $172,500 was appropriated for 750,000 duct feet of conduit construction.

PURVIS, MISS.—The Purvis Light & Power Company has been organized for the purpose of operating an electric light plant, local telephone system and water works and to manufacture ice. The officers are W. H. Magee, president; J. W. Woodward, vice-president and general manager; C. V. Hawthorne, secretary and treasurer.

HIGGINSVILLE, MO.—An electric light plant of 75-kw capacity driven by Ideal engines is being erected at Higginsville. Mr. Fred L. Webster, of St. Louis, is consulting engineer.

ST. LOUIS, MO.—Specifications have been drawn for the installation of two 100-kw and one 200-kw generating units for the new city hospital at St. Louis. The switchboard in connection with these will be equipped with double busbars. This arrangement will permit the separation of the motor and lighting load and will permit one or all the generators to be thrown on either of the systems.

HANNIBAL, MO.—The new generating station for lighting the city of Hannibal, Mo., for which Mr. Fred L. Webster, of St. Louis, Mo., is consulting engineer, will be ready for operation about Oct. 15. The plant is driven by three Allis-Chalmers cross-compound condensing engines, direct-connected to Westinghouse 2300-volt, 60-cycle generators. Two 30-kw exciter sets are driven by Ideal engines. A motor circuit will be supplied through a 125-kw, 500-volt motor generating set. The boiler room contains three 300-hp Stirling boilers generating steam at 160 lbs. pressure. In connection with the boiler plant there has been erected a Steinl improved radial brick stack measuring 150 ft. by 7 ft. 6 ins. Indianapolis Dean jet condensers and feed pumps are installed. The building, 90 ft. by 90 ft., is of fire-proof construction and is of such a size as to permit of installing at a later date an additional generating unit and boilers.

PLATTSBURG, N. Y.—The contract for lighting the streets for a period of 5 years has been awarded to H. A. Lozier, Jr., 1 Broadway, New York, N. Y., at $71 per year per lamp, every night, all night, for 80 2000-cp. enclosed arcs.

WEST POINT, N. Y.—Bids will be received by the Quartermaster, U. S. M. A., on Oct. 6 for the construction of Corliss engines for lighting; also same time and place for the installation of generators, motor generators and switchboard.

BATAVIA, N. Y.—Seth W. Warren, of Buffalo, has purchased the plant of the Consolidated Gas & Electric Company. The purchasers of the property intend to acquire the building of the Consolidated Industries Company, remodel and equip the entire plant throughout, and form a company to operate it as a gas and power plant.

LEXINGTON, N. C.—Bonds amounting to $60,000 are reported sold to be used for water works, an electric light plant and street improvements.

COLUMBUS, OHIO.—The Columbus Railway & Light Company has obtained an injunction restraining the city from enforcing its ordinance fixing the rate for current for lighting at 5 cents per kilowatt-hour. The matter will be fought out in court and it is of great interest as it affects the electric light situation all over the State.

MARYVILLE, TENN.—The Rockford Electric Company, with a capital of $50,000, has applied for a charter to establish an electric light and power plant, to furnish light and power for Maryville and other places. Jos. Burger, J. A. Goddard and Saml. Walker are reported interested.

SALT LAKE CITY, UTAH.—James J. Chambers, of New York, is the promoter of an electric power plant to be built a short distance from the city, the energy to be derived from the Big Cottonwood and Little Cottonwood streams. The development of about 2800 horse-power is planned. The power will be used for lighting purposes and the operation of mines.

FOND DU LAC, WIS.—The Fond du Lac Water Company has in contemplation the installation of an electric plant for operating its pumping station.

MILWAUKEE, WIS.—John I. Beggs, in behalf of the Milwaukee Electric Railway & Light Company, is stated to have on Sept. 2 offered to make a new contract with the city of the basis of a municipal plant.

CHILLIWACK, B. C.—A by-law has been passed granting J. Burt Morgan permission to install an electric power and light plant here.

MOYIE, B. C.—R. E. Kinsey, of Moyie, writes that it is proposed to construct an electric light and power plant near Moyie, to cost $20,000. Geo. Clother is the engineer.

THE ELECTRIC RAILWAY.

SANTA BARBARA, CAL.—The Interurban Railway Company has been incorporated at Jersey City, N. J., with a capital of $250,000, to construct an electric railway here.

LEWISTON, IDA.—A company is to be organized for the construction of an electric railway between this city and Kendall. Lewiston parties will have the controlling interest in the company, which plans the expenditure of about $100,000 on the system. The aid of eastern capitalists is being enlisted for the construction of an electric railway, which will cover a wide range of agricultural territory, beginning in this city. A total distance of about 100 miles will be traversed, the expenditure being estimated at $2,500,000. The company will also establish a power plant on the Clearwater River.

CHICAGO, ILL.—The directors of the Chicago City Railway Company have declared a dividend of 2¼ per cent. upon the capital stock.

TERRE HAUTE, IND.—The Dorsey Construction Company, of this city, has incorporated. The company proposes to do general contract work and make a specialty of building street and interurban railroads. Wm. C. Dorsey, William H. Harris and James E. Dorsey, incorporators.

WINONA, IND.—The stockholders of the Warsaw-Goshen Interurban Company held a meeting Aug. 27 and determined to begin the work of construction of the road at once. It is the intention of the company to buy the franchises and rights of way of the Elkhart, Napanee, Warsaw & Winona Company, not financed. The following officers were elected: H. J. Heinz, of Pittsburg, president; J. F. Beyer, of Warsaw, vice-president; S. C. Dickey, of Indianapolis, secretary and general manager; Thomas Kane, of Chicago, treasurer. J. M. Studebaker, of South Bend, heads the board of directors.

HUTCHINSON, KAN.—The Arkansas Valley Interurban Railway Company has increased its capital stock to $1,500,000. The plan of the company is to build a network of lines to connect Hutchinson, Wichita, Winfield, Wellington and Arkansas City.

LOUISVILLE, KY.—The Louisville Railway Company has filed amendments to its articles of incorporation increasing its capital stock by $1,100,000.

OMAHA, NEB.—The East Omaha car house of the Omaha & Council Bluffs Railway Company was destroyed by fire a few days ago, together with several cars and a number of car bodies. The loss is placed by the company at about $30,000.

ALBION, N. Y.—The Albion & Lockport Railway has been incorporated. Capital, $260,000. The directors are all residents of Western New York.

ALBANY, N. Y.—The Albion & Rochester Railway has been incorporated to build a street surface line from the town of Albion, Orleans County, to Rochester. Capital, $300,000. The directors are all Western New Yorkers.

BUFFALO, N. Y.—The Buffalo, Hamburg & Aurora Railway Company has been reorganized as the Buffalo & Southern Railway. The new corporation is capitalized at $1,960,000. Its directors are Louis L. Babcock, Edward M. Mills and Franklin D. Locke, of Buffalo; G. Tracy Rogers, of Binghamton; David N. Rumsey and Joseph B. Rumsey, of Oswayo, Pa.; Frank L. Andrews and L. B. Siebert, of Coudersport, Pa.; P. C. Blaisdell, of Bradford, Pa.; Theodore M. Barnesdell, of Pittsburg, and A. B. Emery, of East Aurora.

JAMAICA, N. Y.—The State Railroad Commission gave a public hearing last week on the application of the newly incorporated South Shore Traction Company for permission to construct a sixty-mile trolley road through Suffolk and Nassau Counties, Long Island. James Anderson Hawes and Arthur Hume signed the application as vice-president and secretary of the company. The proposed route is from Central Avenue in Jamaica to Rockville Centre, to Hempstead, to Oyster Bay, to Babylon, to Amityville, to Islip, to Patchogue, and easterly to Carman's River in the township of Brookhaven. Much of the line as laid out is through private property, and the application is made on the grounds of public convenience and necessity, and the paucity of transit facilities in the districts it is intended to serve.

BROOKHAVEN, N. Y.—Prospects for a trolley railroad from Jamaica, L. I., to the Connetquot Brook, near Brookhaven, a distance of nearly sixty miles, agitate the inhabitants of the South Shore. Rockville Center, Baldwins, Merrick, Freeport, Bellmore, Seaford, Massapequa, Amityville, Lyndenhurst, Babylon, Bayshore, Islip, East Islip, Great River, Oakdale, West Sayville, Sayville, Bayport, Blue Point, Patchogue and Bellport are among the villages through which the road will pass, chiefly over a private right of way, if built. James Anderson Hawes, vice-president, and Arthur Hume, secretary of the South Shore Traction Company, are the applicants for permission to build, on which a hearing is in progress before the State Railroad Commission in New York. As the projected line parallels the Montauk division of the Long Island Railroad, vigorous opposition is expected. (See above item.)

CLEVELAND, OHIO.—The Roberts & Abbott Company, of Cleveland, is preparing the plans and specifications for the equipment of the Michigan & Indiana Traction Company.

MANSFIELD, OHIO.—The Westinghouse Company is preparing estimates on the cost of equipping the Mansfield & Eastern Railway, which has been projected to connect Mansfield and Ashland. David Morrison, of Cleveland, is president of the company.

SALEM, ORE.—Present indications seem to point to the ultimate realization of the Salem-Dalles Electric Railway, to connect at the latter point with the Dalles Falls City Railway.

GALION, OHIO.—Surveys are under way for the new electric railway from Galion to Marion by way of Iberia, Martel and Caledonia. The line will open up the rich clay fields at Iberia, and the company expects to haul much freight. Officers of the new company are C. W. Bechtel, president; C. H. Henkel, secretary, and G. C. Donnenwrite, treasurer.

COLUMBUS, OHIO.—The Scioto Valley Traction Company has decided to commence work immediately on an extension of the Circleville division to Kingston, and next spring this will be extended to Chillicothe. The plan of extending the Lancaster branch to the coal fields of Hocking County is being discussed, but no action has been taken.

YORK, PA.—Power is now being furnished to the York County Traction Company from the plant of the York Haven Water & Power Company at York Haven.

McKEESPORT, PA.—The Pittsburg, McKeesport & Greensburg Electric Railway Company has decided to build a connecting link between Irwin and Trafford City, thereby completing the connection between Fairchance and Pittsburg. The line will be about 5 miles long.

PHILADELPHIA, PA.—The Philadelphia Rapid Transit Company, through one of its subsidiaries, the Willow Grove Electric Railway Company, will build a new line from Eighteenth Street and Germantown Avenue through new territory to Willow Grove. The new line will be 12½ miles long. It is said an issue of $1,000,000 bonds will be made to pay for construction.

POTTSTOWN, PA.—It is proposed to convert the abandoned Delaware & Atlantic Railroad into an electric railway. This road, which was built many years ago and was operated with indifferent success for a year or two, is 11 miles long and extends from a point 2 miles west of Phœnixville to the Falls of French Creek. It is proposed to continue the line to Bridgeport, passing through Valley Forge.

CLEARFIELD, PA.—Surveys are now being made for a 25-mile electric railway to connect Patton, St. Boniface, Hastings, Barnesboro, St. Benedict, Bakerton and Carrolltown, all located in the bituminous coal fields of North ern Cambria County. W. H. Denlinger, of Patton, is president of the company that will build the line, and Harry Bigler, of Clearfield, is treasurer. Clearfield capital is largely interested.

BONHAM, TEX.—Arrangements have been made in Bonham and McKinney for the construction of the proposed electric railway between those cities. The officers of the company that will build the line are F. W. Potter, of Chicago, president; Dr. J. H. Morrow, of Blue Ridge, vice-president; A. Rasmus, of Chicago, treasurer; E. Townes, of Houston, secretary.

APPLETON, WIS.—Cars are being operated over the new interurban line between Kaukauna and Green Bay. It is now possible to ride from Fond du Lac to Green Bay, a distance of 70 miles.

LOGAN, UTAH.—B. Mahlen, of this city, has been granted a franchise to operate an electric street railway system here.

WILLARD, UTAH.—The City Council has granted to the B. Mahler Company a franchise for the operation of an electric railway in this city. The company is seeking similar concessions in numerous other cities in the State.

CHILLIWACK, B. C.—The Chilliwack Light & Power Company will build an electric railway to connect with New Westminster.

NEW INDUSTRIAL COMPANIES.

THE KNEESE ELECTRIC COMPANY has been incorporated at Jersey City with a capital of $125,000. Incorporators: Edward J. Burt, Clyde Colt and William Meaking.

THE PFINGST ELECTRIC MANUFACTURING COMPANY, of Kittery, Me., has been organized with a capital stock of $500,000. The officers are: President, O. Summer Paul; treasurer, Jesse B. Forsyth.

THE UNIVERSAL ELECTRIC COMPANY, Birmingham, Ala., has been incorporated with a capital stock of $100,000. The incorporators are J. H. Thompson, Dan Rogan, G. G. Sharpe, A. W. Nelson and J. H. Parker.

THE SALAMANCA ELECTRIC TRAFFIC COMPANY, of Salamanca, N. Y., has been incorporated with a capital stock of $20,000. The incorporators are Wm. P. Phinney, Englewood, N. J.; P. C. Benedict and John J. Inman, Salamanca.

THE SURGEONS ELECTRIC COMPANY, Newburg, N. Y., has been incorporated with a capital stock of $50,000, for the manufacture of electrical appliances. The incorporators are H. H. Childs, Russell Sturges, New York City, and M. B. Ziegler, Newark, N. J.

LEGAL.

THE SWAN ELECTRIC MFG. COMPANY.—William J. Wilson has obtained a judgment against the Swan Electric Mfg. Company, of New York, for $15,190. Theodore C. Wallace has been appointed receiver.

INSULATED LINING.—The Yost Electric Mfg. Company of Toledo, Ohio, announces that in a suit brought by the General Electric Company against it for infringement of the Painter patent for insulating lining made of a single piece of fibre tubing, the patent was held to be void for want of patentable novelty in view of prior art. It is stated that the decision was handed down by Judge Hazel of the United States Circuit Court, Southern District of New York, July 30.

OBITUARY.

MR. P. W. MOEN.—Philip W. Moen, of Worcester, formerly of the Washburn & Moen Mfg. Company, died on September 12 from a stroke of apoplexy. He was a director of the Worcester Consolidated and Boston & Worcester street railways.

EDUCATIONAL.

THE MICHIGAN COLLEGE OF MINES, Houghton, Mich., while primarily intended for the training of mining engineers, now offers to the student laboratory practice with lecture and text-book courses in electrical engineering, certain courses in mechanical engineering and physics being required for admission to the classes. Including the class of 1903, there have been graduated from this college 244 students, of whom 70 were from Michigan. The Fall term will begin Friday, September 30.

TECHNOLOGY CLUB OF SYRACUSE.—On January 6, 1904, the Technology Club of Syracuse was organized at Syracuse, N. Y., with a charter membership of 129, including engineers, architects, analytical chemists, metallurgists and geologists. The object of the organization is the promotion of professional and social intercourse among the members. The headquarters of the club are located at No. 707 Dillaye Building, where rooms have been suitably furnished for library and social purposes. Meetings are held monthly, except during the months of June, July, August and September. The annual election of officers will take place at the October meeting. The following officers were elected at the organization meeting: Prof. John E. Sweet, president; Dean Willian Kent, first vice-president; Mr. Henry C. Allen, second vice-president; Mr. Edward N. Trump, Mr. John H. Barr, Mr. Edmund L. French, Mr. James A. Randall, directors; Mr. Alexander T. Brown, treasurer; Mr. A. Frederick Witmer, secretary. On June 4 last the club took a trip over the Auburn & Syracuse Electric Railway to Auburn, N. Y., where several large manuacturing plants and the power house of the railway were visited. These visits to manufacturing plants are to be made one of the special features of entertainment and instruction.

PERSONAL.

WM. ALBERT HALL.

MR. WM. ALBERT HALL, manufacturers' agent of electrical supplies, Cincinnati, Ohio, whose portrait we present herewith, has been in that city six years. Prior to that time he lived in Boston, where he received his business education. He was an apprentice under his father, Mr. Thomas Hall, and afterward became a member of the firm under the style of Thos. Hall & Son, manufacturers, dealers and importers of electrical supplies. The old Hall store in Boston was known throughout the country as a center for scientific and mechanical apparatus, and Thomas Hall built some models that are historical and "in the books." After moving to Cincinnati, Mr. W. A. Hall established himself in the electrical supply business on a small scale, and the business grew to the extent of his organizing a stock company. He has recently sold out his interest in this company and established himself as manufacturers' agent there, in a suite of offices which are well adapted for the purpose. Mr. Hall is very widely known in the electrical field, has many friends throughout the country, and he enjoys the respect and confidence of those who have dealt with him. Thirty years of experience in manufacturing and selling electrical goods qualifies him admirably to conduct an enterprise such as he is now engaged in.

MR. G. R. DECKER, of the Platt Iron Works Company, of Dayton, Ohio (successor to the Stilwell-Bierce & Smith-Vaile Company), was in New York this week.

PROF. J. W. RICHARDS, past president of the American Electrochemical Society, has just returned home per "Germanic" in time to attend the International Electrical Congress at St. Louis. He has been spending four months in Europe, chiefly in Norway.

SIR WILLIAM RAMSAY, the great English chemist, has had a notably warm and cordial reception here, in connection with the convention of the Society of Chemical Industry and has naturally had to undergo a good deal of interviewing. The result is that he has added to his list of discoveries.

MR. C. O. BAKER, president of Baker & Company, Inc., platinum refiners and manufacturers, of Newark, N. J., and New York City, returned last week from an extended European trip. He reports that the prices of crude platinum have been very materially affected by the drafting of the laborers from the Ural mines, owing to the Russo-Japanese war, and, notwithstanding recent advances, a further rise in prices seems almost assured.

MR. G. MARCONI is expected to reach the United States within a fortnight. Directly after his arrival, it is reported, steps will be taken to inaugurate the regular trans-Atlantic service operating between Poldhu, England and Glace Bay, Nova Scotia. It is anticipated that the trans-Atlantic wireless service will be receiving and sending messages on a commercial scale early in 1905. This business would have been put in operation much sooner, but it was deemed advisable to await the result of legislation before the English Parliament. This legislation has now been secured and insures the co-operation of the postal department in England and the Marconi system for the transmission of messages.

MESSRS. MARK BARY and GEO. E. SCHREIBER announce that they have formed a partnership under the firm name of Bary & Schreiber, mechanical and electrical engineers, with offices in the Mermod & Jaccard Building, St. Louis. They will act as consulting and supervising engineers in the complete equipment of lighting and railway systems and in the mechanical and electrical equipment of buildings for manufacturing, offices, hotels or other purposes. Special attention will be paid to tests, reports, machine design, etc. Mr. Schreiber was until recently connected with Messrs. Ford, Bacon & Davis, engineers, of New York and Kansas City. Mr. Bary was for a number of years with Mr. H. H. Humphrey, the well-known consulting engineer, of St. Louis.

Trade Notes.

NORTHERN ELECTRIC MFG. COMPANY, of Madison, Wis., has issued a neat little map and directory for the St. Louis fair. It serves as a handy pocket guide.

THE GENERAL INCANDESCENT ARC LIGHT COMPANY, New York City, furnished the Frank Adams Electric Company, of St. Louis, with all of the oil switches for the distribution of high tension current at the various buildings of the St. Louis Exposition. This order was of considerable magnitude.

GREGORY ELECTRIC COMPANY.—We have received advices from the Gregory Electric Company, Chicago, in which it says that it has just issued its September bargain sheet in which some very desirable late type machines are listed at very interesting prices and that this company is in exceptional position to make prompt shipments. It reports business as excellent, August shipments having been the largest of the year.

THE NATIONAL-ACME MANUFACTURING COMPANY, Cleveland, in a pamphlet recently issued states that during the past twelve months it has converted upward of five million pounds of iron, steel and brass into finished product, in the parts of the Acme automatic screw machines. The Acme machines are characterized by compactness of construction, rapidity of operation and diversity of output. The Acme automatic multiple spindle screw machine is designed to give an output three or more times as great as that of any single spindle screw machine.

MACHADO & ROLLER, 203 Broadway, New York City, have taken the Eastern sales agency for the dynamos and motors manufactured by the Fidelity Electric Company of Lancaster, Pa. This concern makes a specialty of small apparatus and of special motors, such as polishing and buffing devices, elevator motors, vertical type motors, small rotary converters for transforming direct into alternating current for therapeutic work, etc. Machado & Roller will carry a complete line of representative sizes in stock in New York, both for exhibition purposes and to enable them to make prompt deliveries.

PUMPING MACHINERY AT ST. LOUIS.—Forty types of pumping machinery at the St. Louis Exposition are described and illustrated in a handsome pamphlet, 8½x12 ins., now being distributed by the International Steam Pump Company, of 114 Liberty Street, New York City. Under this heading are included not only the many types of pumps exhibited, but also air compressing and steam condensing apparatus, cooling towers, vacuum machines, water meters, etc. The processes in which these machines are employed on the Exposition grounds, such as timber preserving and refrigeration, are fully explained, and diagrams and graphical charts are employed to illustrate the design and arrangement of apparatus. A striking view of the Grand Cascade is shown on the cover, and the immense Worthington turbine pumps by which the water is supplied are described in the text. This publication is distributed gratis.

SELF-SOLDERING HEAT COILS.—Frank B. Cook, of 239 West Lake Street, Chicago, has been meeting with the most flattering success with his No. 444 protector, which is equipped with self-soldering heat coils. This protector is manufactured under Mr. Cook's patents, and it has been giving the best satisfaction to the many companies who have installed it. Some of the recent shipments of complete distributing frames equipped with No. 444 protectors have been those to the Pittsburg & Allegheny Telephone Company, for its Homestead exchange, a frame equipped for 600 lines, with an ultimate capacity of 700 lines; the United Telephone & Telegraph Company, of Pittsburg, a frame equipped for 100 lines, with an ultimate capacity of 200, for its exchange at Louisburg, and a frame with a capacity of 100 lines for Norristown. To the Milton & Milton Junction Telephone Company a frame with a capacity of 100 lines for its exchange at Milton Junction, Wis.; the Yuma Tel. Co., Yuma, Ariz., a frame equipped for 105 lines, with an ultimate capacity of 200 lines; the Sabine Valley Telephone Company, of Center, Tex., a frame equipped for 200 lines, with a capacity of 300 lines; the Kentucky & Indiana Telephone Company, of Owensboro, Ky., an ultimate capacity of 1300 lines, equipped for 1260; the Albemarle Telephone Company, of Charlottesville, Va., an ultimate capacity of 300 pair, equipped with 100.

NEW YORK INSULATED WIRE.—The first annual outing of main office employes of the New York Insulated Wire Company was held Saturday, Sept. 10, at New Dorp, Staten Island, and was thoroughly enjoyed by the boys, young and old. The afternoon began with a spirited foot race between M. J. English, the storekeeper, and F. B. Nimmo, the price clerk. This resulted in a tie, much to the annoyance of both contestants, for each felt certain of victory and had expressed himself in very forceful language. Next came the potato race which aroused much interest for a time, and Mr. W. C. Hall, Jr., the popular manager, carried off the prize amid cheers. Owing to the illness of Mr. P. H. Hover, who was confined to his bed with enlargement of the heart, the fat man's race was called off. The arrival of the baseball teams was the signal for Staten Island "fans" to gather, and their open-mouthed wonder showed that nothing so speedy had ever been seen in that vicinity before. The features of the game were the long slide of Mr. J. F. Kelly and the home run by Mr. L. O. Brewster, which showed they had not lost their old-time skill. The efficient manner in which H. P. Reid reached third base where there was something doing, indicated that he was in better physical condition than when looking for insurance. The dinner was certainly all that could be desired, and was a credit to the committee—H. W. Jenkins, chairman; E. A. Haaker, treasurer, and N. W. Biggart, press agent. The clams were unanimously voted to be the most dangerous imitation of Grimshaw specialties that had come under observation in some years. Before leaving the grounds the outing was considered by all a decided success and it was voted unanimously to repeat it each year.

NATIONAL ELECTRIC PORCELAIN COMPANY, of East Liverpool, Ohio,

has had a business proposition submitted to it by the Commercial Club of Dayton, Ohio, for the removal of its factory and plant to the latter city. The company is capitalized at $100,000, of which $50,000 is common stock and $50,000 preferred. The parties controlling the business are to receive $30,000 of common stock and the balance of the common stock is not to be sold; $35,000 of the preferred stock, entitled to cumulative dividends at the rate of 7 per cent. per annum, payable semi-annually, will be offered to the citizens of Dayton and vicinity at the par value thereof, and $17,500 of common stock will be given as a bonus to the subscribers of the preferred stock. The balance of the preferred stock, $15,000, will not be sold until after the $35,000 of the same has been disposed of and then at the rate determined by the officers of the company, but in no event less than 75 per cent. of the par value thereof. No bonus of common stock will be given with the sale of the preferred stock, held in reserve by the company. The company reserves a right to redeem the preferred stock for five years by paying to the holders thereof the sum of the par value thereof with 10 per cent. additional and all accrued dividends. All subscriptions of the preferred stock will be paid to the Third National Bank of Dayton, Ohio, as trustee, to be used and paid out by such trustee upon proper vouchers in the construction of the buildings and machinery necessary to equip said factory. The secret process and formulas, owned and controlled by the managers of the said company, will be transferred to the said company with proper safeguards and the $30,000 of common stock, which is to go to the present managers of the company, will also be held by the trustee for the period of two years, as a guarantee to the company when located in or near Dayton, and the faithful performance of the contract which said managers will make with the new organization.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED SEPTEMBER 6, 1904.

[Conducted by Rosenbaum & Stockbridge, Patent Attys., 140 Nassau St., N. Y.]

769,195. BRUSH HOLDER FOR ELECTRIC GENERATORS; Leon R. Smith, Pendleton, Ind. App. filed Apr. 13, 1904. Two tubes for pencil brushes are held in a block which screws into a suitable holder.

769,198. FLOOR TREAD; William J. Tonkin, Ansonia, Conn. App. filed Jan. 23, 1904. A star-shaped plate placed concentrically above and insulated from a circular plate, its arms being free to be pressed into contact with the lower plate.

769,203. ELECTRIC SIGNAL; William T. Wheeler, St. Louis, Mo. App. filed Nov. 7, 1903. A push button formed by a lens behind which a small lamp is located to show the location of the button at night.

769,214. BLOCK SWITCH AND SIGNAL SYSTEM FOR ELECTRIC RAILROADS; Thomas F. Gaynor, Brooklyn, N. Y. App. filed Aug. 19, 1902. Details.

769,228. ELECTRIC CIRCUIT CLOSER; John K. Norstrom and Henry M. Graif, Chicago, Ill. App. filed May 20, 1903. A circuit closer adapted for "calling" in telephone circuits and consisting of a break wheel which closes the circuit a definite number of times by the continuous movement of an actuating member.

769,236. ELECTRODE HOLDER FOR ELECTRIC HEADLIGHTS; Mark A. Ross, Chicago, Ill. App. filed Oct. 15, 1903. The electrode is gripped laterally between two jaws pivoted together and normally forced toward each other by a spring, the rear end of the electrode being supported upon an adjustable screw.

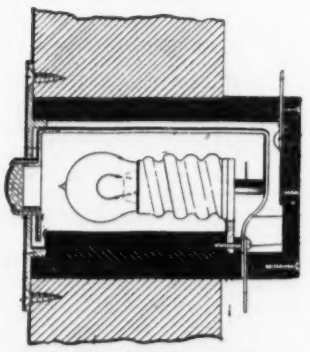
769,240. SAFE; Benjamin F. Sparr, New York, N. Y. App. filed Sept. 3, 1903. Details of a circuit closer actuated when the door of a safe is opened.

769,273. INCLOSED ELECTRIC ARC LAMP; Henry C. F. M. Petitdidier and Theodore M. Schmitt, Paris, France. App. filed Nov. 10, 1903. Details of the carbon feeding and controlling mechanism.

769,279. APPARATUS FOR SIGNALING TO TRAINS; Joseph Seel, Manchester, England. App. filed March 19, 1904. Details.

769,303. MEANS FOR SUPPORTING ELECTRICAL LAMPS; William B. Churcher, Cincinnati, Ohio. App. filed Dec. 26, 1899. A lamp socket is provided with an armature at its rear end which is attracted and held by a permanent magnet fixed to the wall or other support of the lamp.

769,304. TELEPHONE; William B. Churcher, Cincinnati, Ohio. App. filed April 26, 1900.



769,203.—Electric Signal.

769,306. TELEPHONE OR TELEGRAPH SYSTEM; Frederick E. Denzer and William W. Black, Everett, Wash. App. filed Sept. 3, 1902.

769,342. METHOD OF REGULATING ALTERNATING-CURRENT GENERATORS AND CIRCUITS; Ludwig Gutmann, Peoria, Ill. App. filed June 29, 1904. (See Current News and Notes.)

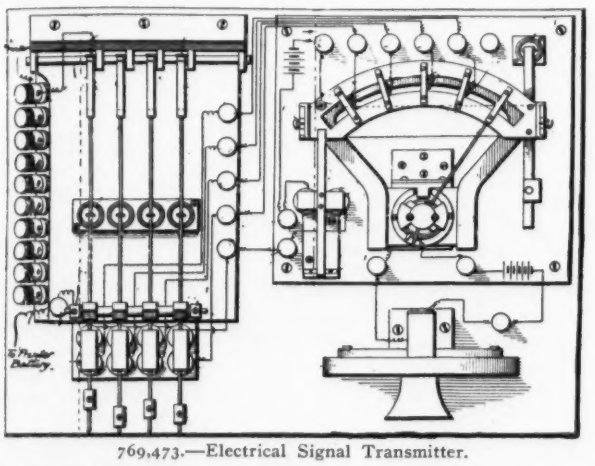
769,406. MEANS FOR CONTROLLING AND REGULATING ELECTRIC MOTORS; Gustaf Rennerfelt, New York, N. Y. App. filed Nov. 9, 1903. Means for automatically operating the controller so as to obtain an increase in the speed of the motor and means for stopping said operating means when the rate of speed increase exceeds a predetermind limit.

769,409. ELECTRIC SIGNALING SYSTEM; Paul H. Schmitt, Chicago, Ill. App. filed Nov. 30, 1903. A signal box having two circuit closing wheels facing each other and a contact finger projecting between them, with a magnet determining which of the wheels the finger shall cooperate with, thus making the box operative on either an open or a closed circuit.

769,433. INFLUENCE MACHINE; Isaac W. Detwiller, Buffalo, N. Y. App. filed Oct. 17, 1901. The starter or exciter is made a constituent part of and operative with the generator.

769,462. SELF-ADJUSTING TROLLEY FOR ELECTRIC RAILWAYS; Charles C. Benson, Newburyport, Mass. App. filed Nov. 19, 1902. A construction of the harp permitting the wheel to swing laterally.

769,473. ELECTRICAL SIGNAL TRANSMITTER; Arthur C. Ferguson, Brooklyn, N. Y. App. filed Jan. 30, 1904. The mechanism of the invention consists of a code signal transmitting device coupled with word-selecting devices, both of which are operated through the medium of the undulations of a closed circuit, together with electro-mechanical devices which serve to convert a word or signal into its letters in the regular order of their succession and to operate printing mechanism to print the letters in their proper succession. Words spoken into a telephone transmitter are received and printed at the other end of the line.



769,473.—Electrical Signal Transmitter.

769,540. AUDIBLE INDICATOR FOR ELECTRIC LIGHT OR ELECTRIC MOTOR CIRCUITS; Joseph P. Gillette, New London, Conn. App. filed Dec. 22, 1903. Details of a device similar to a buzzer and adapted to be placed in circuit with a translating device to give an audible signal in case the current is allowed to flow through the translating device unintentionally.

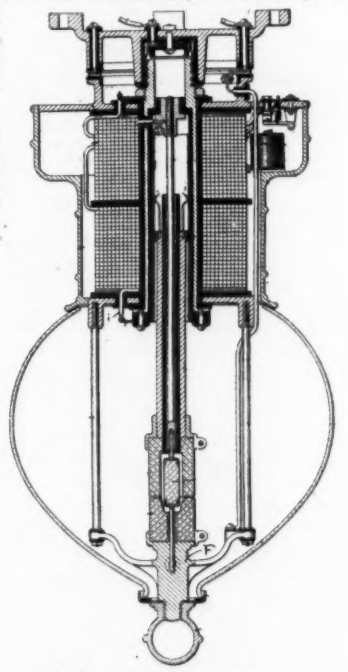
769,572. TIME LIMIT DEVICE FOR ELECTRIC SWITCHES; Samuel B. Stewart, Jr., Schenectady, N. Y. App. filed May 31, 1902. A slow acting switch intended to prevent opening of a circuit by reason of fluctuating interruptions at another point in the circuit.

769,598. THERMAL CUT-OUT; William L. R. Emmet, Schenectady, N. Y. App. filed Dec. 4, 1899. For the reception of fuses placed in shunt to the contact of a circuit breaker for protection to the same, tubular chambers having suitable outlets for gases and of such shape and direction to properly conduct away the gases, are provided.

769,599. BRUSH HOLDER; William L. R. Emmet, Schenectady, N. Y. App. filed Dec. 22, 1900. Details.

769,619. STARTING RHEOSTAT; Frederick Mackintosh, Schenectady, N. Y. App. filed July 26, 1901. A rheostat controlling a pump motor in which the arm does not go to the "off" position until after the pump motor circuit is broken, thus preventing arcing at the rheostat contacts.

769,637. ELECTRIC LAMP; Edwin W. Rice, Jr., Schenectady, N. Y. App. filed July 8, 1899. A lamp in which the luminous medium is a non-conductor at ordinary temperatures, provided with means for forming an arc in proximity to the medium, which, upon the flow of current through said medium, is extinguished and maintained so during the operation of the lamp.



769,637.—Electric Lamp.

769,638. REGULATION OF ELECTRIC CURRENTS; Howard R. Sargent, Schenectady, N. Y. App. filed Nov. 28, 1900. Details of a switch.

769,639. CLEAT; Howard R. Sargent, Schenectady, N. Y. App. filed March 26, 1902. A holder for wires consisting of similar halves each having a high portion, a low portion and an intermediate curved or seat portion.

769,646. CONNECTION BOX; Frank E. Case, Schenectady, N. Y. App. filed Feb. 20, 1903. A connection box provided with an opening large enough to receive a number of cable ends and having filler blocks to close that portion of the opening not occupied by the cable ends.

769,652. HIGH POTENTIAL ENERGY DETECTOR; John D. Hilliard, Jr., Glens Falls, N. Y. App. filed March 13, 1903. The device consists of induction plates suitably supported for safe handling and so arranged that by their condenser action a discharge takes place in the form of sparks, when one of the plates is brought into the neighborhood of a highly charged conductor.

769,658. TELEPHONE RECEIVER; Ray H. Manson, Chicago, Ill. App. filed Aug. 3, 1903.

769,685. ELECTRIC RAILWAY SWITCH; Schuyler C. Gurley, Indianapolis, Ind. App. filed Sept. 8, 1903. Details of an electro-magnet for throwing the switch tongue of railways.

HOLOPHANE PAGODAS

CHICAGO HOLOPHANE GLASS COMPANY NEW YORK

PATENTED JUNE 28, 1904

To fit Standard 2 1-4 in. Holder

(All cuts one-third actual size)

2622

2633
(Plain edge is 2632)

2623

2662

2651
(Plain edge is 2650)

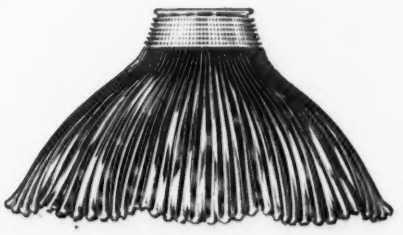
2663

2682

2683

To fit Special 1 5-8 in. Holder Furnished Free with each Reflector

2631
(Plain edge is 2630)



2621
(Plain edge 2620)

2657

2656

NOTICE—In order to distinguish the Holophane CONCENTRATING reflector from the Holophane DIFFUSING globe the Trade-name "PAGODA" has been adopted for Holophane reflectors

HOLOPHANE SCIENTIFIC GLASSWARE IS PROTECTED BY THE FOLLOWING PATENTS

Nos. 563,836, July 14, 1896; 593,348, Nov. 9, 1897; 30,266, Feb. 28, 1899; 634,295, Oct. 3, 1899; 31,353, Aug. 8, 1899; 31,354, Aug. 8, 1899; 31,355, Aug. 8, 1899; 31,356, Aug. 8, 1899; 31,357, Aug. 8, 1899; 31,358, Aug. 8, 1899; 31,359, Aug. 8, 1899; 32,286, Feb. 27, 1900; 32,685, May 22, 1900; 32,686, May 22, 1900; 655,728, Aug. 14, 1900; 33 996, June 29, 1901; 679,770, Aug. 6, 1901; 679,771, Aug. 6, 1901; 687,848, Dec. 3, 1901; 35,616, Jan. 28, 1902; 35,684, Feb. 4, 1902; 35,755, Feb. 18, 1902; 35,756, Feb. 18, 1902; 35,757, Feb. 18, 1902; 35,682, Feb. 4, 1902; 35,683, Feb. 4, 1902; 36,215, Feb. 3, 1903; 36,214, Feb. 4, 1903; 732,211, June 30, 1903; 762,926, June 21, 1904; 762,927, June 21, 1904; 763,688, June 28, 1904; 763,689, June 28, 1904. Other patents pending.

The General Electric Company have adopted Holophane "Pagodas" exclusively for use with their celebrated "Meridian," and other electric lamps.

The following well-known lamp companies endorse and use Holophane "Pagodas" as being the most efficient and decorative reflectors on the market, namely: Bryan-Marsh Co., The Columbia Incandescent Lamp Co., Sunbeam Incandescent Lamp Co., The Buckeye Electric Co., Fostoria Incandescent Lamp Co., The Shelby Electric Co., The Indepeadent Incandescent Lamp Co., The Warren Electric and Specialty Co., The Colonial Electric Co., The New York and Ohio Co., and all the leading electric lamp manufacturers of the United States.

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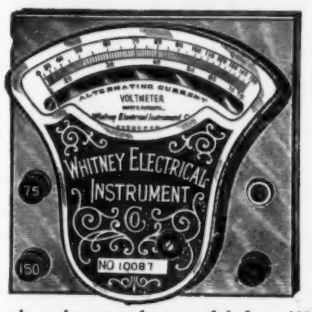

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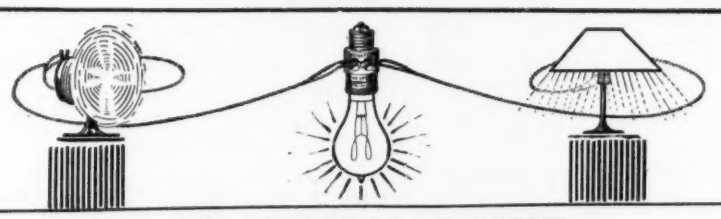

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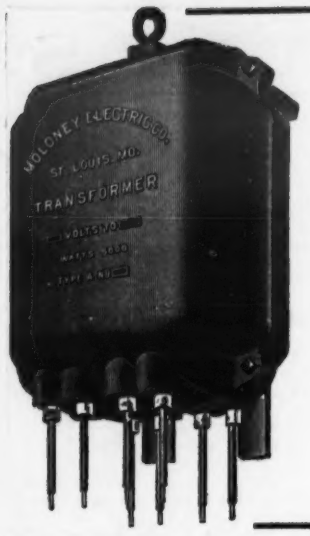

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